THE ECOLOGY OF THE PHYTOPLANKTON OF PRUDHOE BAY, ALASKA, AND THE SURROUNDING WATERS

A

THESIS

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ABSTRACT

The primary productivity, chlorophyll *a* concentration, nutrient concentration and phytoplankton standing stock were determined in Prudhoe Bay, Alaska, and the surrounding waters during spring and summer of 1971 and 1972. During July and August a pelagic diatom community, dominated by *Chaetoceros socialis* Lauder, *Nitzschia delicatissima* Cleve and *Thalassiosira nordenskiöldii* Cleve, occurring in the high salinity deep water layer, had a primary productivity of 0.7-21.2 mg C m^{-3} hr^{-1}, while a flagellate community, occurring in the brackish surface water, had a primary productivity of 0-1.0 mg C m^{-3} hr^{-1}. Pennate diatoms were dominant in Prudhoe Bay late in July 1971, and had a primary productivity of 1.3-12.3 mg C m^{-3} hr^{-1}. During summer the nitrate nitrogen concentration was usually below 1 µg-atom $liter^{-1}$ and was probably limiting growth. A maximum chlorophyll *a* concentration of 9.8 mg m^{-2} was recorded in the bottom layer of sea ice off Prudhoe Bay in May, indicating that ice algae may contribute significantly to the annual primary productivity.

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INTRODUCTION

Recently environmental quality and protection have become national issues. Greater populations and industrial development are placing heavier demands on the environment and subjecting it to new stresses resulting from exploration and waste disposal. The Torrey Canyon and Santa Barbara oil spills, among others, have caused much concern as to the possibility of serious and perhaps permanent environmental damage which could result from petroleum contamination. Therefore, the recent exploration and development of the Alaskan North Slope oil reserves and their proposed shipment across the state by pipeline have generated much controversy.

When oil development began on the North Slope there was practically no biological data available on any of the Alaskan arctic coast to the east of Point Barrow. Scientific information was accumulating from other areas, however, which indicated that oil contamination is seriously harmful to a large variety of organisms (Mironov 1973; United States Department of the Interior 1972). This, coupled with the fact that arctic ecosystems are subject to a high degree of stress (Dunbar 1968), suggested that a potential hazard to the environment existed from industrial development. An extensive study was therefore undertaken of the Colville River and the nearby tundra lakes and shallow lagoons so that baseline data would be available to aid in formulating policy decisions for development (Kinney et al. 1971). Scientific information on the unaltered environment was also necessary to allow evaluation of any changes resulting from industrialization.

It was decided that in addition to the Colville River study, a detailed examination of the phytoplankton community of Prudhoe Bay and the surrounding waters should be undertaken, because Prudhoe Bay is the site of the major oil drilling and the northern terminus of the proposed Trans-Alaska pipeline. The phytoplankton community was selected for study because phytoplankton are the major energy source upon which the marine food web is based and any large changes in the phytoplankton composition would affect the entire ecosystem. The goals of this study were to 1) describe the phytoplankton community in terms of species composition and relative numbers of individuals present, 2) determine the primary productivity, 3) estimate the possible contribution of the ice algae to the spring productivity, and 4) determine the major environmental parameters influencing primary productivity, including nutrient concentrations, salinity, temperature and water transparency.

1.2 Literature Review

The first biological collections along the arctic coast of Alaska were made by the Canadian Arctic Expedition, 1913-1918. The diatoms in these collections were analyzed by Mann (1925).

Although most of the samples were collected from the bottom mud, some net tows were taken, but only the larger plankton species were representented, for example *Chaetoceros decipiens* Cleve, *Ch. atlanticus* Cleve, and *Ch. diadema* (Ehrenberg) Cleve (=*Ch. subsecundus* (Grunow) Hustedt) in Harrison Bay and *Chaetoceros decipiens*, *Ch. laciniosus* Schütt and *Thalassiosira gravida* Cleve off Plover Island. The majority of the species listed by Mann were benthic pennate diatoms taken from the mud samples, and are therefore not common in the plankton. These were the only phytoplankton data available from the Alaskan arctic coast for several decades.

Phytoplankton samples were collected in the Russian arctic coastal seas by Soviet investigators during the 1920's and '30's. Most of the samples were taken with plankton nets but some water samples were concentrated for numerical analysis. The available data are summarized by Usachev (1947) and an English review is available in Zenkevitch (1963). The Barents sea is characterized by a bimodal phytoplankton cycle. *Phaeocystis* is the dominant form during the spring bloom in May along the coast. Dinoflagellates become more dominant during the fall bloom, which occurs sometime from July to September. This annual pattern extends eastward into the north Kara Sea. The southern Kara and Laptev seas are very brackish due to run-off from the Ob, Yenisey and Lena rivers. Species characteristic of the highly dilute regions are *Aphanizomenon flos aque* (Linne)

Ralfs, *Melosira italica* (Ehrenberg) Kützing, *M. islandica* O. Müller, *M. granulata* (Ehrenberg) Ralfs and *Asterionella gracillima* (Hantzsch) Heiberg. *Diploneis* spp. and *Navicula* spp. were dominant brackish water forms. Marine forms encountered further offshore include *Thalassiosira baltica* (Grunow) Ostenfeld, *Coscinodiscus marginatus* Ehrenberg, *Chaetoceros gracilis* Schütt, *Ch. wighami* Brightwell, *Peridinium breve* Paulsen, *P. pellucidum* (Bergh) Schütt and others. The annual phytoplankton cycle in the southern Kara and Laptev seas is more unimodal than that of the Barents Sea. The spring and fall peaks tend to fuse and the productive season lasts from June into September. The percentage contribution of the dinoflagellates to the total phytoplankton biomass becomes less as one moves eastward across the Kara and Laptev seas, and that of the diatoms increases. Usachev (1947) claims that this is because dinoflagellates are generally boreal forms and not well adapted to the more arctic environment of these seas.

The Chukchi Sea is similar to the Barents Sea, in having an intense spring phytoplankton bloom as the ice breaks up (Zenkevitch 1963). Diatoms such as *Chaetoceros socialis* Lauder, *Ch. furcellatus* Bailey, *Thalassiosira gravida*, *Fragilariopsis islandica* Grunow, *Fr. oceanica* Cleve, and *Bacterosira fragilis* Gran were most common. Zenkevitch suggested that the spring bloom is terminated by nutrient exhaustion and that low nutrient levels and high zooplankton populations cause low phytoplankton concentrations throughout the summer.

The next mention of phytoplankton from the Alaskan arctic was made by MacGinitie (1955). Although his work was concerned mainly with the benthic marine invertebrates, he included a rough analysis of the plankton. Phytoplankton were described by shape (circular, spiny, chain type, iridescent, spicule), and their relative abundance was recorded. MacGinitie reported highest phytoplankton concentrations in September, and although a spring bloom was also reported to occur in June, it did not appear to be as intense as the September bloom.

Bursa (1961) studied the seasonal succession of the phytoplankton community near Igloolik Island in the Canadian arctic and found that the major factor influencing diatom abundance in the surface waters during spring and summer was salinity. Between early May and 15 July the salinity fell from 32.5°/₀₀ to 1.68°/₀₀ and during this period the surface populations were reduced considerably. Brackish water species such as *Chaetoceros socialis*, *Ch. wighami*, and *Nitzschia pungens* Cleve became more abundant during this time. The surface populations did not recover until the salinity rose to 31.5°/₀₀ during the first weeks of August. Although dinoflagellates were quite rare in Bursa's samples, holozoic forms were more common than autotrophic ones and it was postulated that this reflects the advantage of holozoic nutrition during the long arctic winter. The maximum phytoplankton population at Igloolik Island occurred in August and September. This pattern is similar to that reported by MacGinitie for the Point

Barrow area.

Bursa (1963) also studied the taxonomy of the phytoplankton community near Point Barrow. Samples were taken from Elson Lagoon, tundra ponds, melt ponds on the sea ice, and offshore waters. Brackish water plankton predominated in Elson Lagoon because the lagoon is shallow and receives a large influx of fresh water. Bursa found that *Chaetoceros socialis*, *Ch. wighami*, and *Goniaulax catenata* (Levander) Kofoid, which were rare in the plankton outside the lagoon, were common inside it. In addition, he reported large numbers of unidentified flagellates.

The nearshore community at Point Barrow was also reported to contain many flagellates. Populations of Coccolithophorideae, *Polytomella* sp., *Pyramimonas* sp. and unidentified forms varied from 1-27 thousand cells per liter. *Goniaulax tamarensis* Lebour was also common in the nearshore waters.

The offshore waters contained more oceanic forms. *Chaetoceros concavicornis* Mangin, *Ch. eibenii* Grunow, *Ch. subtilis* Cleve, *Leptocylindrus danicus* Cleve, and *Cylindrotheca closterium* Reimann and Lewin (=*Nitzschia closterium* (Ehrenberg) W. Smith) were some of the diatoms mentioned. *Dinobryon balticum* (Schütt) Lemmermann was also reported in large numbers in the offshore waters.

Horner (1969) studied the phytoplankton succession near Point Barrow for three consecutive years and found that the annual cycle was bimodal. The first maximum took place in June and early July before ice breakup. *Phaeocystis pouchetii* (Hariot) Lagerheim was the dominant species and *Chaetoceros gracilis* Schütt, *Fragilariopsis oceanica*, *Cylindrotheca closterium*, *Thalassiosira gravida*, and *T. nordenskiöldii* Cleve were also common. During the second bloom in August *Chaetoceros gracilis*, *Ch. socialis*, *Ch. wighami* and *Cylindrotheca closterium* were most common and *Dinobryon balticum* was also abundant.

Nutrient concentrations were also followed throughout the spring and summer cycle. The highest concentrations occurred during the spring bloom before the ice went out. They subsequently dropped, probably due to uptake by phytoplankton and dilution as the ice melted. Phosphate and silicate were probably not limiting but nitrate concentration was below 1 μg-atom NO_3-N liter^{-1}, and it was suggested that this may have been limiting.

Horner concluded that some variation in the general pattern can occur due to physical parameters such as movement of water masses, time of ice breakup and weather conditions, but the basic bimodal cycle is always present.

The Federal Water Pollution Control Administration (Faas 1969) published a report summarizing the information available on the major estuarine systems of the United States. Included was a short article by Faas on ice stresses estuarine systems, which discussed shoreline erosion, productivity, flora and fauna, and the environmental stresses placed upon these systems by ice conditions.

According to Faas, arctic estuaries are subjected to extreme annual salinity fluctuations due to the desalting process which occurs as salt water freezes. If the water body is isolated, anoxic as well as hypersaline conditions can occur. Darkness and very low temperatures prevail throughout the winter and the phytoplankton populations are subjected to intense osmotic shock as the estuarine water changes from hypersaline to highly dilute conditions under the influence of spring run-off.

Faas' discussion was limited to Elson Lagoon and Esatkuat Lagoon near Barrow, and the phytoplankton discussion consisted of a summary of Bursa (1963) because this was the only phytoplankton data available on Alaskan arctic estuaries at that time. Faas expressed the need for further study, especially of those areas undergoing exploration and development by oil interests.

The Colville River project, mentioned above, was initiated in responce to this need. The project was interdisciplinary, covering such topics as nearshore currents, sedimentation and beach erosion, water chemistry, nutrient cycling, phytoplankton and zooplankton biology, primary productivity, epibenthic fauna and bird populations. Two progress reports (Kinney et al. 1971 and Kinney et al. 1972) have been completed and contain the data which are so far available.

The water chemistry and nutrient cycling were studied by Schell (Kinney et al. 1972). Winter data from Simpson Lagoon indicate that pockets of isolated water are formed as the ice thickens and the salinity in these water pockets increases above 50°/₀₀ by spring. The increase in nitrate concentration was proportional to that of salinity indicating that nitrification was not occurring or was occurring very slowly. This is in contrast to the deep water channels of the Colville River delta, where nitrification was an active process. Schell suggested that nitrification may have been completed in the lagoon before the onset of freeze concentration. Phosphate showed no recognizable correlation with salinity and the reason for this was not given.

During spring the salinity in Simpson Lagoon and Harrison Bay dropped considerably due to ice melt and fresh water run-off, and this was accompanied by a pronounced decrease in nutrient concentration. Nitrate concentration fell below the detectable level of 0.02 μg-atoms NO_3-N liter^{-1} and ammonia concentration dropped to 20-30% of the spring values. Although nitrate concentration in the river was quite high, it was insufficient to enhance productivity in Simpson Lagoon or Harrison Bay, except near the river delta. According to Schell, the low winter inorganic nitrogen to phosphate ratio (5:1) in Simpson Lagoon is indicative of severe nitrogen limitation in these nearshore waters. Dissolved organic nitrogen concentration was quite high (3-6 μg-atoms DON-N liter^{-1}), but Schell felt that this nitrogen source was not available to the phytoplankton because of inhibition of ammonification by low water temperatures. Silicate concentration was quite high in the nearshore waters (up to 14 μg-atoms H_4SiO_4-Si liter^{-1}) due to river run-off. The silicate concentration in the river water was 29.9-33.0 μg-atoms H_4SiO_4-Si liter^{-1}, and Harrison Bay and the Beaufort Sea had silicate concentrations of 4.5-8.4 μg-atoms liter^{-1}.

Alexander and Billington (Kinney et al. 1972) examined the chlorophyll *a* concentration and primary productivity in Simpson Lagoon and Harrison Bay. The chlorophyll *a* concentration was usually below 1 mg m^{-3}, but the phaeophytin concentration was high indicating large amounts of inactive pigment, and they suggested that this was caused by fresh water algae which died when exposed to the brackish lagoon water. Primary productivity averaged 1 mg C m^{-3} hr^{-1} with occasional values in excess of 5 mg C m^{-3} hr^{-1}. The low productivity was attributed to low nutrient concentrations.

A final report on the Colville River project is now in preparation and will summarize the information collected during the three year study. These data are particularly relavent to the Prudhoe Bay study since the two environments are very similar.

1.3 Description of the Study Area

Prudhoe Bay (70° 20' N, 148° 25' W) is about 300 km east of Point Barrow. It is 5 km wide by 5 km long with a maximum depth of 2.5 m. The bay is bordered on the seaward side by a shoal area whose maximum depth is 1.2 m. A small river, the Putuligayuk, empties directly into Prudhoe Bay on the west shore. The Sagavanirktok, a major North Slope river, empties just to the east of Prudhoe Bay. Barrier islands border the coast, forming a series of lagoons about 11 km wide with a maximum depth of about 8 m.

Prudhoe Bay is subjected to subfreezing temperatures nine months of the year. Ice begins forming in October and reaches a maximum thickness of about 2 m in late May. In early June the rivers breakup flooding the ice. Melt off continues into July and is followed by a period of open water lasting into October, but broken ice is occasionally seen drifting within the lagoons and outside the barrier Islands.

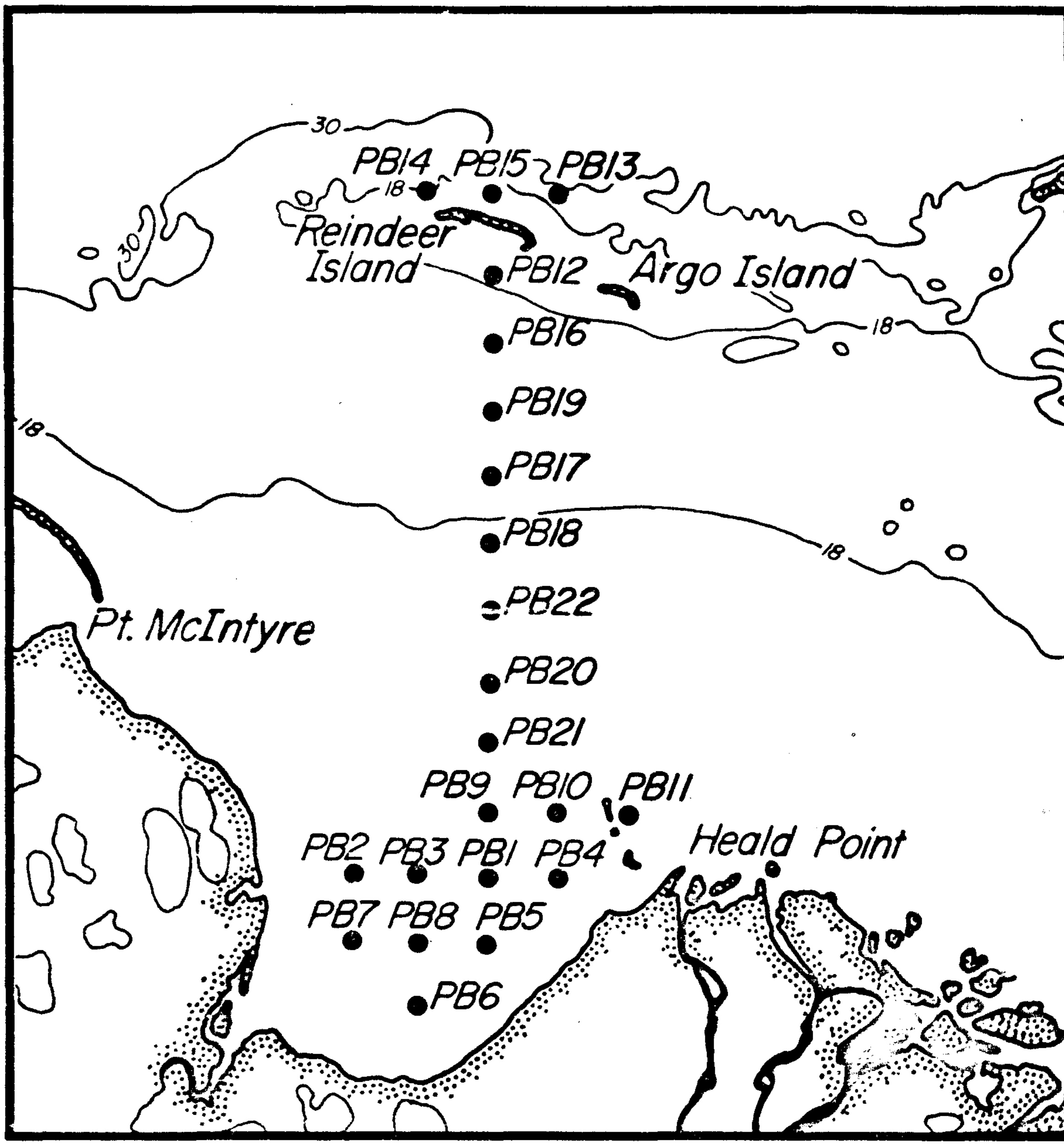
METHODS

2.1 Sampling

Because of ice conditions the winter and spring sampling technique differed from the summer sampling technique. Two sites were selected for winter and spring sampling. One site was located about 1 km north of Reindeer Island and corresponds to station PB 15 (Fig. 1). The second site was located approximately in the center of Prudhoe Bay and corresponds to station PB 8 (Fig. 1). It was necessary to sample the deepest part of the bay because the ice is nearly 2 m thick by May, therefore all areas less than 2 m deep were frozen to the bottom. These two sites allowed the comparison of Prudhoe Bay and offshore conditions. The winter and spring sampling in 1971 was done on 27 March and 10 May, and during 1972 it was done on 2 February, 18 May and 25 May.

At each site a core was cut from the ice with an ice corer. The length of the core was measured and 10-15 cm sections were cut from the top, middle and bottom parts of the core. The samples were taken back to the Naval Arctic Research Laboratory in plastic containers and allowed to thaw at room temperature. After thawing, subsamples were taken for chlorophyll, salinity and nutrient determinations, and for cell counts. A 4-l water sample was dipped from each of the core holes with a 500 ml polyethylene bottle and used for similar measurements.

Fig. 1. Stations taken during Cruise I, 24-29 July 1971.



30
PB14
PB15
PB13
18
30
Reindeer Island
PB12
Argo Island
PB16
18
PB19
18
PB17
PB18
18
PB22
Pt. McIntyre
PB20
PB21
PB9
PB10
PB11
PB2
PB3
PB1
PB4
Heald Point
PB7
PB8
PB5
PB6

Fig. 2. Stations taken during Cruise II, 15-19 August 1971.

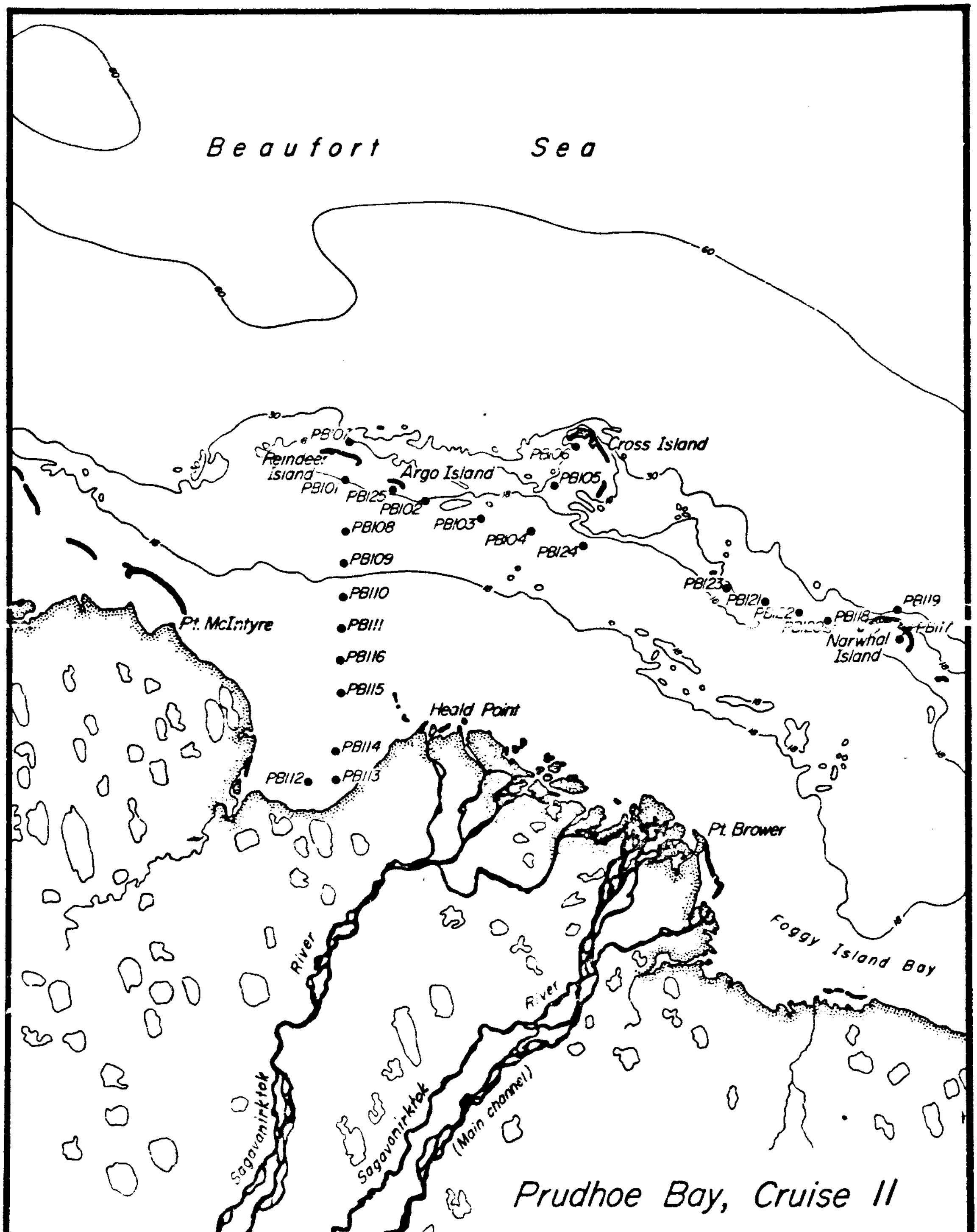
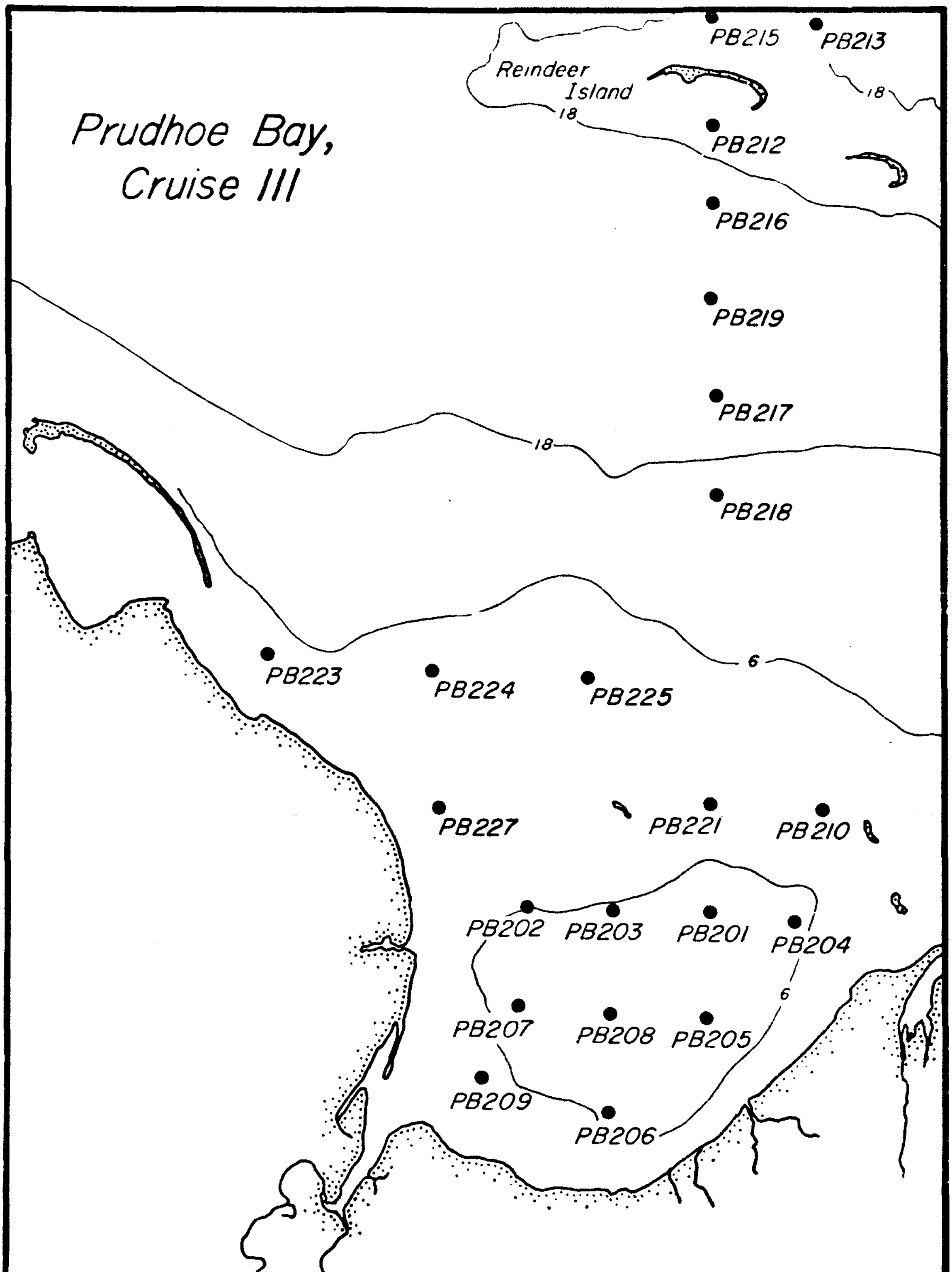

Beaufort Sea
Reindeer Island
Argo Island
Cross Island
Pt. McIntyre
Heald Point
Pt. Brower
Narwhal Island
Foggy Island Bay
PB101
PB102
PB103
PB104
PB105
PB108
PB109
PB110
PB111
PB112
PB113
PB114
PB115
PB116
PB118
PB119
PB121
PB123
PB124
PB125
Sagavanirktok River
Sagavanirktok River
(Main channel)
Prudhoe Bay, Cruise II

Fig. 3. Stations taken during Cruise III, 11-15 August 1972.


Prudhoe Bay,
Cruise III
Reindeer
Island
18
PB215
PB213
PB212
PB216
PB219
PB217
PB218
PB223
PB224
PB225
6
PB227
PB221
PB210
PB202
PB203
PB201
PB204
PB207
PB208
PB205
PB209
PB206

Summer sampling was done from the research vessel *Natchik*. Three cruises were made to Prudhoe Bay. Cruise I took place 24-29 July 1971, Cruise II took place 15-19 August 1971, and Cruise III occurred 11-15 August 1972. The locations of the stations taken during each of the three cruises are shown in Figures 1-3.

During Cruises I and II, two water samples were taken at stations deeper than 2.5 m, one from the surface and one from just above the bottom. During Cruise III stratification of the water column at the deep stations was indicated by a salinity discontinuity measured with a Beckman RS5-3 salinity probe. At these stations two water samples were taken, one from the surface layer and one from the deep layer below the discontinuity. At shallower stations showing no discontinuity, one sample was taken about half way between the surface and the bottom. A summary of the samples taken at each station and the measurements made on each sample is given in Tables 1-3.

The water samples were taken with a 6-l non-toxic Van Dorn type sampling bottle and transfered to a 4-l polyethylene bottle. After shaking, subsamples were poured from the 4-l bottle for chlorophyll, nutrient and salinity measurements, and for phytoplankton standing stock samples. About half of the stations sampled during the three cruises were selected for primary productivity measurements (Table 1-3). The water for these experiments was also taken from the 4-l samples. Nitrate and ammonia uptake experiments were done at the primary productivity stations during Cruises I and II. The water for

Table 1. Summary of the samples taken at each station during Cruise I and the measurements made on each sample. All depths are in meters.

Station Number	Station Depth	Sample Depth	Measurements Made[1]
PB 1	2.3	0	C, P, N
PB 1		2	C, P, N
PB 2	2.0	1.5	C
PB 3	1.5	0.8	C
PB 4	2.0	1.0	C
PB 5	2.5	0	C, P
PB 5		1.5	N
PB 5		2.0	C, P
PB 6	2.0	1.5	C, P, N, Ph
PB 7	2.0	1.5	C, Ph
PB 8	2.5	1.5	C, P, N, Ph
PB 9	1.8	1.5	C, Ph
PB 10	1.0	0	C, N, P, Ph
PB 11	0.5	0	C, Ph
PB 12	4.0	0	C, P, Ph
PB 12		2.0	N
PB 12		3.5	C, P, Ph
PB 13	4.0	0	C, Ph
PB 13		3.5	C, Ph
PB 14	4.5	0	C, Ph
PB 14		4.0	C
PB 15	5.3	0	C, P
PB 15		2.5	N
PB 15		4.5	C, P
PB 16	7.0	0	C
PB 16		6.0	C, Ph
PB 17	6.5	0	C
PB 17		6.0	C, Ph
PB 18	5.0	0	C
PB 18		4.5	C
PB 19	6.0	0	C, Ph
PB 19		2.5	N
PB 19		5.5	C, Ph
PB 20	2.3	1.5	C, N, Ph
PB 21	1.5	1.0	C, Ph
PB 22	2.3	1.5	C, P, N, Ph

[1] C = chlorophyll *a*, nutrient and salinity measurements.
Ph = phytoplankton standing stock sample.
P = primary productivity measurement.
N = nitrate and ammonia uptake measurement and a particulate nitrogen concentration measurement.

Table 2. Summary of the samples taken at each station during Cruise II and the measurements made on each sample. All depths are in meters.

Station Number	Station Depth	Sample Depth	Measurements Made[1]
PB 101	5.0	0	C, P, Ph
PB 101		2.5	N
PB 101		4.5	C, P, Ph
PB 102	5.0	0	C
PB 102		4.5	C, Ph
PB 103	4.5	0	C
PB 103		4.0	C, Ph
PB 104	5.5	0	C, P
PB 104		3.0	N, Ph
PB 104		5.0	C, P
PB 105	6.0	0	C, Ph
PB 105		4.5	C
PB 106	6.0	0	C, Ph
PB 106		5.5	C
PB 107	10.0	0	C, P
PB 107		5	N, Ph
PB 107		9.5	C, P
PB 108	7.0	0	C, P
PB 108		3.5	N, Ph
PB 108		6.5	C, P
PB 109	6.0	0	C, Ph
PB 109		5.5	C
PB 110	5.0	0	C, Ph
PB 110		4.5	C, Ph
PB 111	2.8	1.5	C
PB 112	2.5	1.0	C, P, N, Ph
PB 113	2.5	1.0	C, Ph
PB 114	2.5	1.0	C, Ph
PB 115	1.3	0	C
PB 116	1.3	0	C
PB 117	4.0	0	C, P
PB 117		2.0	N, Ph
PB 117		3.5	C, P
PB 118	6.0	0	C, Ph
PB 118		5.5	C, Ph
PB 119	9.5	0	C, P
PB 119		5.0	N, Ph
PB 119		9.0	C, P
PB 120	8.5	0	C, Ph
PB 120		8.0	C, Ph
PB 121	7.5	0	C, Ph
PB 121		7.0	C, Ph
PB 122	8.0	0	C, P
PB 122		4.0	N, Ph
PB 122		7.5	C, P
PB 123	5.0	0	C, P
PB 123		4.5	C, P, N, Ph
PB 124	7.0	0	C
PB 124		6.5	C
PB 125	3.0	1.5	C

[1]Symbols same as in Table 1.

Table 3. Summary of the samples taken at each station during Cruise III and the measurements made on each sample. All depths are in meters.

Station Number	Station Depth	Sample Depth	Measurements Made[1]
PB 201	2.8	1.0	C
PB 202	2.5	1.0	C
PB 203	2.5	1.3	C, P, Ph
PB 204	2.3	1.0	C
PB 205a	2.5	1.0	C
PB 205b	2.5	1.0	C, P, Ph
PB 206	2.0	1.0	C, P, Ph
PB 207	2.5	1.0	C
PB 208	3.0	1.0	C, P, Ph
PB 209	2.1	1.0	C, Ph
PB 210	1.0	0	C, P, Ph
PB 212	4.5	0	C, P, Ph
PB 212		4.0	C, P, Ph
PB 213	10.0	0	C, P, Ph
PB 213		8.0	C, P, Ph
PB 215	11.0	0	C, Ph
PB 215		8.0	C, Ph
PB 216	6.5	0	C, Ph
PB 216		5.0	C, Ph
PB 217	6.5	0	C, P, Ph
PB 217		5.0	C, P, Ph
PB 218	4.0	0	C, Ph
PB 218		4.0	C
PB 219	7.0	0	C, Ph
PB 219		5.0	C, Ph
PB 221	1.3	0	C
PB 223	1.2	1.0	C, P, Ph
PB 224	1.5	0	C
PB 225	1.8	0	C
PB 227	1.3	0	C

[1] Symbols same as in Table 1. No particulate nitrogen or ammonia and nitrate uptake measurements were made during Cruise III. Salinity measurements were not made at stations PB 201, 202, 204, and 207.

these experiments was usually collected at an intermediate depth between the surface and deep water samples. Particulate nitrogen was also measured at the nitrate and ammonia uptake stations so that uptake rates could be calculated. Nitrate and ammonia uptake rates were not measured during Cruise III. During Cruise II the samples for cell counts were usually taken from the water collected for particulate nitrogen measurements.

2.2 Chlorophyll *a* concentration

One liter water samples were filtered through Millipore HA 0.45 μm filters for chlorophyll analysis. Two drops of saturated $MgCO_3$ solution were added to the last several milliliters of water in the filter tower and the remaining water was filtered through. The edges of the filters were trimmed off, the filters were folded into quarters, put in labeled envelopes and frozen for later analysis.

The samples were analyzed according to the UNESCO SCOR (1966) technique. During Cruise III replicate water samples were collected and filtered for chlorophyll measurements, and the chlorophyll *a* concentration was determined using both the UNESCO SCOR (1966) technique and that of Lorenzen (1967). The results of the chlorophyll *a* analysis are compiled in Tables 8-11.

2.3 Alkalinity and Primary Productivity

Samples for alkalinity measurements were taken at each primary productivity station. The water samples were poured into 125-ml polyethylene bottles, poisoned with two drops of 0.5% mercuric chloride, and later analyzed using a Coleman model 37-A pH meter according to the method of Strickland and Parsons (1968).

The effect of preserving the alkalinity samples with mercuric chloride instead of analyzing them immediately was tested. Twelve alkalinity bottles were filled from a single water sample. Six of the alkalinity samples were analyzed immediately and six were poisoned with two drops of mercuric chloride and allowed to stand at room temperature for a week before alkalinity was determined. A one way analysis of variance indicated that the means of the poisoned and unpoisoned samples were not different at the 1% confidence level.

Primary productivity was measured according to the technique described by Steemann Nielsen (1952). For each sample on Cruises I and II, one light and one dark bottle were incubated on deck in a plastic bucket for six hours. During incubation the samples were cooled by periodically pouring sea water over them. After incubation the samples were filtered through Millipore HA 0.45 μm filters. The filters were rinsed with 5 ml of 0.005N HCl, placed in plastic petri dishes, and stored in a desiccator until they could be counted. They were counted on a Nuclear Chicago D-47 gas flow proportional counter and the ampoules were standardized by the barium carbonate precipitate technique and extrapolation to zero thickness.

During Cruise III one dark and two light incubations were done on each sample. The incubation bottles were placed in plastic tubes covered with 1% and 10% light screens. The bottles containing the surface samples were incubated in clear plastic tubes. During the four hour incubation the samples were cooled by pumping surface sea water through the plastic tubes. After incubation the samples were filtered as described above. The wet filters were placed in 10-ml counting vials containing Aquasol[R] (NEF-934), a liquid scintillation cocktail. The samples were counted on a Nuclear Chicago model 6848 liquid scintillation system and efficiency was determined by the channels ratio method.

The primary productivity in mg C m^{-3} hr^{-1} was calculated according to the equations given by Strickland and Parsons (1968). The results are recorded in Tables 12-15.

2.4 Determination of Community Composition

The water samples for phytoplankton analysis were poured into 250-ml jars, fixed with 4% formalin buffered with sodium acetate, and stored in the dark until counts could be made. The phytoplankton counts were done using the inverted microscope technique described by Utermöhl (1931). For each sample 5 and 50-ml Zeiss settling chambers were used. Each sample was shaken thoroughly, poured into the 5 and 50-ml settling chambers, and allowed to settle for six to eight hours.

[R] New England Nuclear West, 206 Professional Building, El Cerrito Plaza South, El Cerrito, California 94530

In some cases the sediment concentration in the samples was so great that it coated the bottom plate of the 50-ml chamber making examination impossible. In such cases 25 ml of sample was measured with a graduated cylinder and settled in the 50-ml chamber. Occasionally sediment concentration was too high for examination of volumes greater than 5 ml.

The 50-ml chamber was composed of a bottom plate and a 50-ml tube which was attached to the bottom plate with stopcock grease. After settling, about 45 ml of the sample water had to be removed from the chamber so that the tube could be separated from the bottom plate, which was then covered with a glass plate and set on the microscope stage. This was done with a Pasteur capillary pipet and did not appear to disturb the settled cells, as there were no abnormally clear areas on the chamber bottom. The bubbles were removed from the settled samples by picking them out with a pin. The chambers were then covered, placed on the microscope stage, and allowed to settle an additional hour before beginning the counts. All counts were done on a Zeiss phase contrast inverted microscope.

The 5-ml samples from Cruises I and II were counted at 400 X magnification, and those from Cruise III were counted at 500 X. For most of the samples, half of the 5-ml chamber was examined by alternate transects, however, some of the samples were examined by counting every third transect. When the algae in some of the samples were too numerous for this kind of analysis, alternative techniques were used.

If the algal concentration was extremely high, counts were done by examination of a series of fields across the center of the chamber. In a few cases the counts were done by examination of one transect across the center of the chamber. The width of the counting field was measured with a stage micrometer to determine the area of the bottom plate which was examined in these cases. The cell concentration in each sample was calculated by multiplying the number of cells counted by the appropriate factor, as determined from the fraction of the chamber bottom examined, to give the number of cells per liter.

The 50-ml samples were counted by examination of the entire bottom plate of the chamber. The 50-ml samples from the first and second cruises were examined at 100 X magnification and those from the third cruise were examined at 125 X. All cells larger than 40 μm were counted and any smaller cells which could be easily recognized were also enumerated.

Summary sheets of each of the counts are included in Appendix II. Each sheet contains a list of the species and their respective number of cells per liter. All unidentified cells were drawn and their dimensions listed.

2.5 Particulate Nitrogen Concentration, Nitrate and Ammonia Uptake

Particulate nitrogen concentration was measured at each station where nitrate and ammonia uptake experiments were done, so that the uptake rate could be calculated. The water for particulate nitrogen was filtered through Gelman type A prewashed glass fiber filters. The filters were stored in a desiccator and later analyzed on a Coleman model 29 nitrogen analyzer.

Nitrate and ammonia uptake rates were measured according to the technique described by Dugdale and Goering (1967). One light and one dark bottle were incubated for each nitrate and ammonia sample and the samples were incubated for four hours as described above for the ^{14}C experiments done in 1971. After incubation the samples were filtered onto Gelman type A prewashed glass fiber filters, dried, and stored in a desiccator for later analysis. The nitrogen isotope ratio determinations were done on a modified Bendix model 17-210 time of flight mass spectrometer and the results are recorded as the uptake rate in μg liter^{-1} hr^{-1}.

2.6 Environmental Parameters

2.6.1 Nutrient Analysis

The water for nutrient analysis was taken from the water which had been filtered at each station for chlorophyll analysis. During Cruises I and II the sample water was frozen immediately after filtration and during Cruise III the filtered samples were poisoned with two drops of 0.5% mercuric chloride and frozen after returning to the Naval Arctic Research Laboratory.

Nitrate, nitrite, silicate and phosphate analysis was done on a Technicon autoanalyzer according to the technique described by

Strickland and Parsons (1968). Ammonia was determined according to the technique of Solórzano (1969). The Cruise III ammonia concentration was determined by the Solórzano technique as modified by Schell (unpublished) for the autoanalyzer. The results are recorded in Tables 16-20.

2.6.2 Salinity and Temperature Measurements

During Cruises I and II and during spring sampling, the water for salinity measurements was taken from the chlorophyll filtrate. The filtered samples were poured into polyethylene bottles, which were tightly capped until salinity measurements could be made. Salinity was measured on a Beckman model RS 7-B salinometer. During Cruise III salinity was measured with a Beckman model RS5-3 salinity probe, however, several salinity samples were taken from the chlorophyll filtrate as a check on the operation of the salinity probe.

Most temperature measurements were done with a mercury thermometer. During Cruise III temperature measurements were done with the salinity probe. The salinity results are listed in Tables 4-7 and the temperature measurements are listed in the cruise summary sheets in Appendix I.

2.6.3 Water Depth and Transparency

Water transparency was estimated with a 26 cm diameter white Secchi disc. The extinction coefficients were calculated by the formula $K = 1.7/D$, where D is the depth where the Secchi disc disappears from sight. Water depth was measured by lowering the Secchi disc to the bottom.

RESULTS

3.1 Salinity and Temperature

Winter and spring salinity values are listed in Table 4. Salinity is high in Prudhoe Bay during winter and spring due to freeze concentration. The earliest winter value was measured on 2 February 1972, and is higher than the offshore salinity, indicating that free exchange between bay and offshore water is inhibited by the thickening ice as early as January. Freeze concentration continues throughout the winter and spring, and maximum salinity occurs in May. The highest salinity value (72.09°/₀₀) was recorded on 10 May 1971. The salinity was relatively constant between 18 and 25 May 1972, thus indicating that the ice in Prudhoe Bay was not melting at that time.

Sometime between late May and July the Prudhoe Bay salinity falls due to ice melt and fresh water run-off (Tables 5-7). Values were as low as 5.46 and 6.86°/₀₀ during Cruise I at stations near the Sagavanirktok River delta. During all three cruises the salinity in Prudhoe Bay was usually 16-20°/₀₀ and was seldom outside that range.

Winter and spring salinities at the Reindeer Island station were 28.8-35.5°/₀₀, with the highest recorded value occurring on 2 February 1972, and the lowest value on 25 May 1972. Between 18 and 25 May 1972, the salinity fell from 30.58 to 28.80°/₀₀, indicating that ice melt had begun (Table 4).

Salinity and temperature profiles were taken with the salinity probe at stations PB 215 and 217 during Cruise III (Fig. 4). The

Table 4. Salinity (°/₀₀) of the top, middle and bottom ice, and the water from just below the ice, measured in the winter and spring of 1971 and 1972.

	1971			
	Reindeer Island		Prudhoe Bay	
	27 Mar.	10 May	27 Mar.	10 May
Top ice	8.58	8.43	4.24	5.06
Middle ice	4.57	6.91	4.83	5.87
Bottom ice	4.73	22.45	20.23	18.37
Water	30.47	32.09	57.43	72.09

	1972					
	Reindeer Island			Prudhoe Bay		
	2 Feb.	18 May	25 May	2 Feb.	18 May	25 May
Top ice	6.04	5.14	6.52	5.23	3.99	4.20
Middle ice	7.06	5.42	5.29	5.13	5.83	8.14
Bottom ice	5.45	5.71	5.66	5.95	11.74	13.40
Water	35.48	30.58	28.80	45.03	66.11	66.27

Table 5. Salinity ($^{\circ}/_{\circ\circ}$) measured during Cruise I. All depths are in meters.

Shallow Water

Station Number	Sample Depth	Salinity	Station Number	Sample Depth	Salinity
PB 1	0	21.55	PB 11	0	11.46
PB 1	2.0	21.83	PB 12	0	24.33
PB 2	1.5	19.56	PB 13	0	18.07
PB 3	0.8	20.06	PB 14	0	18.26
PB 4	1.0	17.58	PB 15	0	21.03
PB 5	0	19.16	PB 16	0	19.74
PB 5	2.0	21.07	PB 17	0	21.74
PB 6	1.5	19.68	PB 18	0	26.61
PB 7	1.5	18.40	PB 19	0	22.15
PB 8	1.5	13.02	PB 20	1.5	25.67
PB 9	1.5	6.86	PB 21	1.0	25.68
PB 10	0	5.46	PB 22	1.5	24.45

Deep Water

Station Number	Sample Depth	Salinity	Station Number	Sample Depth	Salinity
PB 12	3.5	31.17	PB 16	6.0	31.61
PB 13	3.5	24.37	PB 17	6.0	29.53
PB 14	4.0	25.33	PB 18	4.5	25.03
PB 15	4.5	31.67	PB 19	5.5	28.65

Table 6. Salinity (°/∘∘) measured during Cruise II. All depths are in meters.

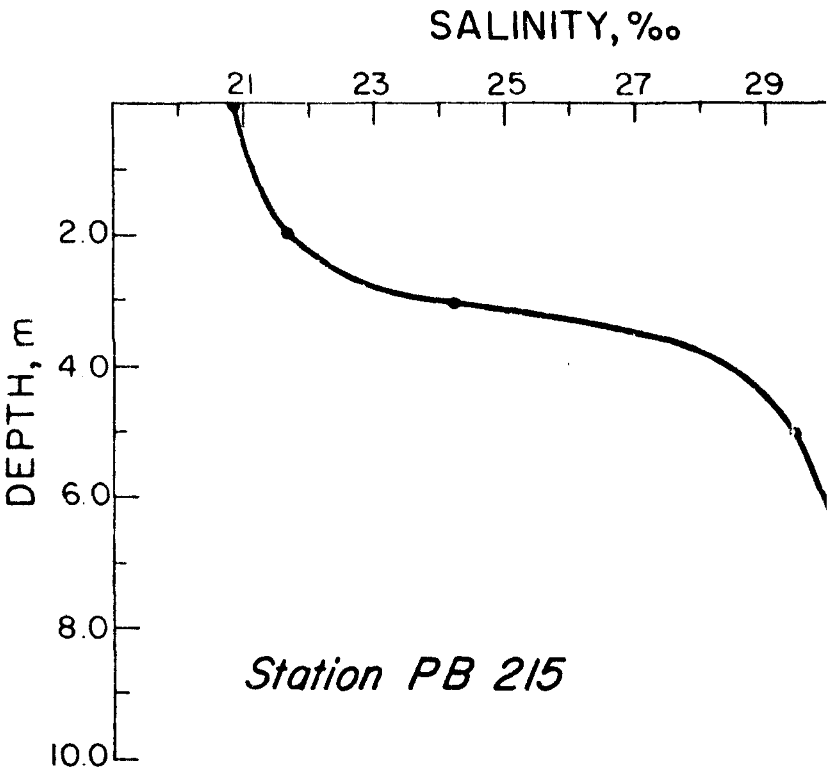
Shallow Water					
Station Number	Sample Depth	Salinity	Station Number	Sample Depth	Salinity
PB 101	0	17.73	PB 111	1.5	16.10
PB 101	4.5	17.86	PB 112	1.0	13.90
PB 102	0	18.40	PB 113	1.0	14.59
PB 102	4.5	18.45	PB 114	1.0	13.52
PB 103	0	18.46	PB 115	0	14.57
PB 103	4.0	18.50	PB 116	0	15.79
PB 104	0	18.35	PB 117	0	19.13
PB 104	5.0	25.85	PB 117	3.5	20.30
PB 105	0	18.35	PB 118	0	18.61
PB 105	4.5	19.23	PB 118	5.5	22.40
PB 106	0	19.01	PB 119	0	18.76
PB 106	5.5	19.39	PB 120	0	18.78
PB 107	0	17.90	PB 121	0	18.89
PB 108	0	16.92	PB 122	0	20.35
PB 109	0	17.27	PB 123	0	18.99
PB 109	5.5	24.45	PB 123	4.5	24.83
PB 110	0	16.13	PB 124	0	18.28
PB 110	4.5	18.34	PB 125	1.5	18.76

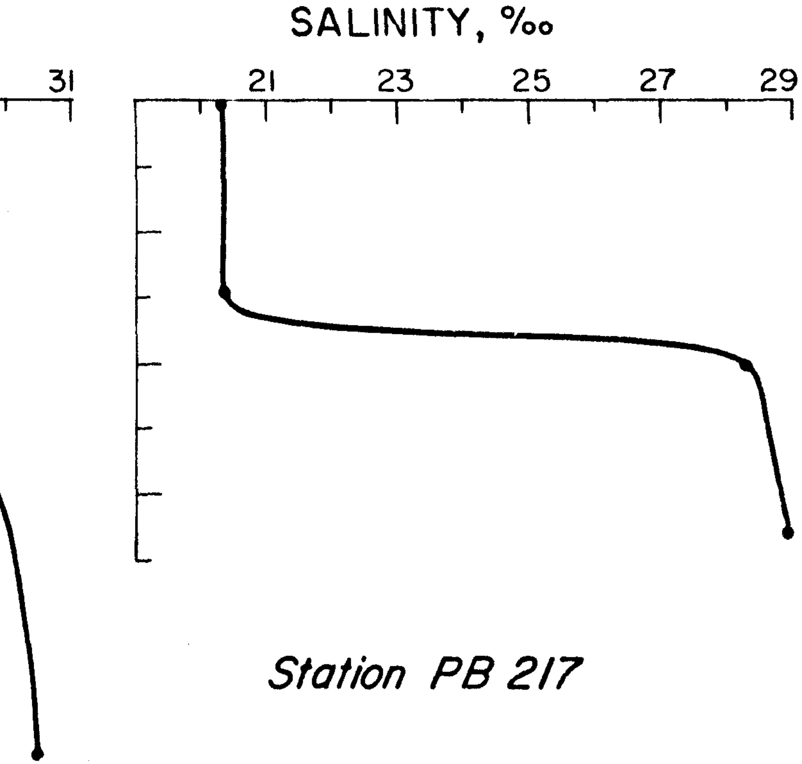
Deep Water					
Station Number	Sample Depth	Salinity	Station Number	Sample Depth	Salinity
PB 107	9.5	30.42	PB 121	7.0	25.91
PB 108	6.5	30.12	PB 122	7.5	26.83
PB 119	9.0	30.09	PB 124	6.5	24.61
PB 120	8.0	30.32			

Table 7. Salinity (°/₀₀) measured during Cruise III. All depth are in meters.

Station Number	Sample Depth	Salinity	Station Number	Sample Depth	Salinity
PB 203	1.3	20.15	PB 216	0	20.49
PB 205a	1.0	19.10	PB 216	5.0	20.54
PB 205b	1.0	16.75	PB 217	0	20.30
PB 206	1.0	19.30	PB 217	5.0	25.75
PB 208	1.0	19.30	PB 218	0	19.90
PB 209	1.0	19.28	PB 218	4.0	19.90
PB 210	0	19.30	PB 219	0	20.29
PB 212	0	20.73	PB 219	5.0	20.62
PB 212	4.0	21.11	PB 221	0	19.55
PB 213	0	21.26	PB 223	1.0	19.01
PB 213	8.0	30.42	PB 224	0	19.68
PB 215	0	20.88	PB 225	0	19.71
PB 215	8.0	30.52	PB 227	0	18.80

Fig. 4. Salinity-Depth profiles at stations PB 215 and 217.


SALINITY, ‰
21
23
25
27
29
DEPTH, m
2.0
4.0
6.0
8.0
10.0
Station PB 215



Station PB 217

surface salinity was below 21°/oo, and between 2 and 5 m increased to above 28°/oo. The salinity value for PB 217-5 m (Table 7) is 25.75°/oo, probably because part of the sampling bottle extended through the salinity discontinuity, therefore a composite water sample was taken which included both deep and shallow water.

The salinity stratification pattern continued eastward along the coast at least as far as Narwhal Island (147° W, 70° 24' N). All of the surface salinities during Cruise II were below 21°/oo (Table 6). This layer reached 5.5 m depth at station PB 106. Generally, however, water samples taken below 5.5 m had salinities above 21°/oo and water taken at 8 m and below had salinities greater than 30°/oo. This same salinity stratification pattern is also indicated by the Cruise I data (Table 5). Surface salinities were less than 22°/oo and increased to a maximum value above 31°/oo below 4.5 m depth. PB 12 is the only station where a salinity above 31°/oo was recorded in water shallower than 4.5 m. This, coupled with the exceptionally high chlorophyll concentration and primary productivity (Tables 9 and 12), indicates an area of localized upwelling. These conditions were observed only during Cruise I. Water with salinity above 28°/oo is hereafter referred to as deep water.

Water temperatures under the ice were always below 0°C, with the lowest value being -4°C measured on 25 May in Prudhoe Bay. Summer surface temperatures were 2-9°C. Within the salinity discontinuity layer the water temperature dropped below 0°C and all temperatures beneath the discontinuity layer were below zero.

3.2 Water Transparency

The Secchi disc measurements for the three cruises are listed in the cruise summary sheets of Appendix I. They indicate that the water transparency inside Prudhoe Bay is very low. Secchi depths measured inside the bay did not exceed 0.75 m during Cruise I and 1 m during Cruises II and III, except at station PB 209 where the depth was 1.3 m. The phytoplankton inside the bay were therefore on the average, exposed to between 1 and 10% of the incident intensity. Microscopic examination of the water indicated that the low transparency was due to large amounts of suspended sediment.

The Secchi depths at stations outside the bay during Cruises I and II were 3.0-7.5 m. The phytoplankton living below the salinity discontinuity layer at 5 m were therefore exposed to between 1 and 25% of the surface light intensity. During Cruise III the stations outside Prudhoe Bay had Shecci depths between 1.5 and 3.5 m, and therefore the algae of the deep layer were exposed to between 1 and 10% of the surface light intensity.

3.3 Chlorophyll *a* Concentration

3.3.1 Ice

The chlorophyll *a* concentration of the ice samples collected during winter and spring is shown in Table 8. The highest chlorophyll concentrations were found in the bottom ice during spring, the maximum recorded value being 97.9 mg m^{-3} measured in the bottom ice off Reindeer Island on 10 May 1971. The bottom ice

Table 8. Chlorophyll *a* concentration in mg m^{-3} measured during winter and spring sampling.

Reindeer Island	1971		1972		
	27 Mar.	10 May	2 Feb.	18 May	25 May
Top ice	7.0	0.7	0.8	0.3	0.8
Middle ice	1.5	0.9	2.2	0.3	0.7
Bottom ice	5.0	97.9	2.1	7.2	4.5
Water	0.9	3.9	0.4	1.7	2.6

Prudhoe Bay	1971		1972		
	27 Mar.	10 May	2 Feb.	18 May	25 May
Top ice	3.6	3.0	1.6	0.6	0.8
Middle ice	1.1	1.2	1.1	0.5	0.8
Bottom ice	5.7	1.7	2.1	1.5	19.0
Water	1.4	0.6	1.4	1.1	2.8

concentration on the same date inside Prudhoe Bay was 1.7 mg m^{-3}. The 1972 data indicate that the ice algal bloom in Prudhoe Bay may occur later than that in the Beaufort Sea off Reindeer Island. Between 18 and 25 May the chlorophyll concentration in the bottom ice in Prudhoe Bay increased from 1.5 to 19 mg m^{-3}. During this same period in the Beaufort Sea off Reindeer Island, the chlorophyll concentration in the bottom ice showed the opposite trend (a drop from 7.2 mg m^{-3} on 18 May to 4.5 mg m^{-3} on 25 May), thus indicating that the ice algal bloom had occurred somewhat earlier.

The highest recorded chlorophyll *a* concentrations in the top and middle ice from Reindeer Island occurred on 27 March 1971 and 2 February 1972 (Table 8). The values measured in May, 1971 and 1972, were usually lower than the earlier winter values, and may indicate a trend of high chlorophyll concentrations in the top and middle ice layers before the beginning of the spring bloom in the bottom ice layer, followed by lower concentrations during and after the bloom. The chlorophyll concentration in the top and middle ice layers from inside Prudhoe Bay on 10 May 1971 was quite high (3.0 and 1.2 mg m^{-3}). This is probably not an exception to the trend, but further evidence that the ice algal bloom inside Prudhoe Bay had not begun by the sampling date.

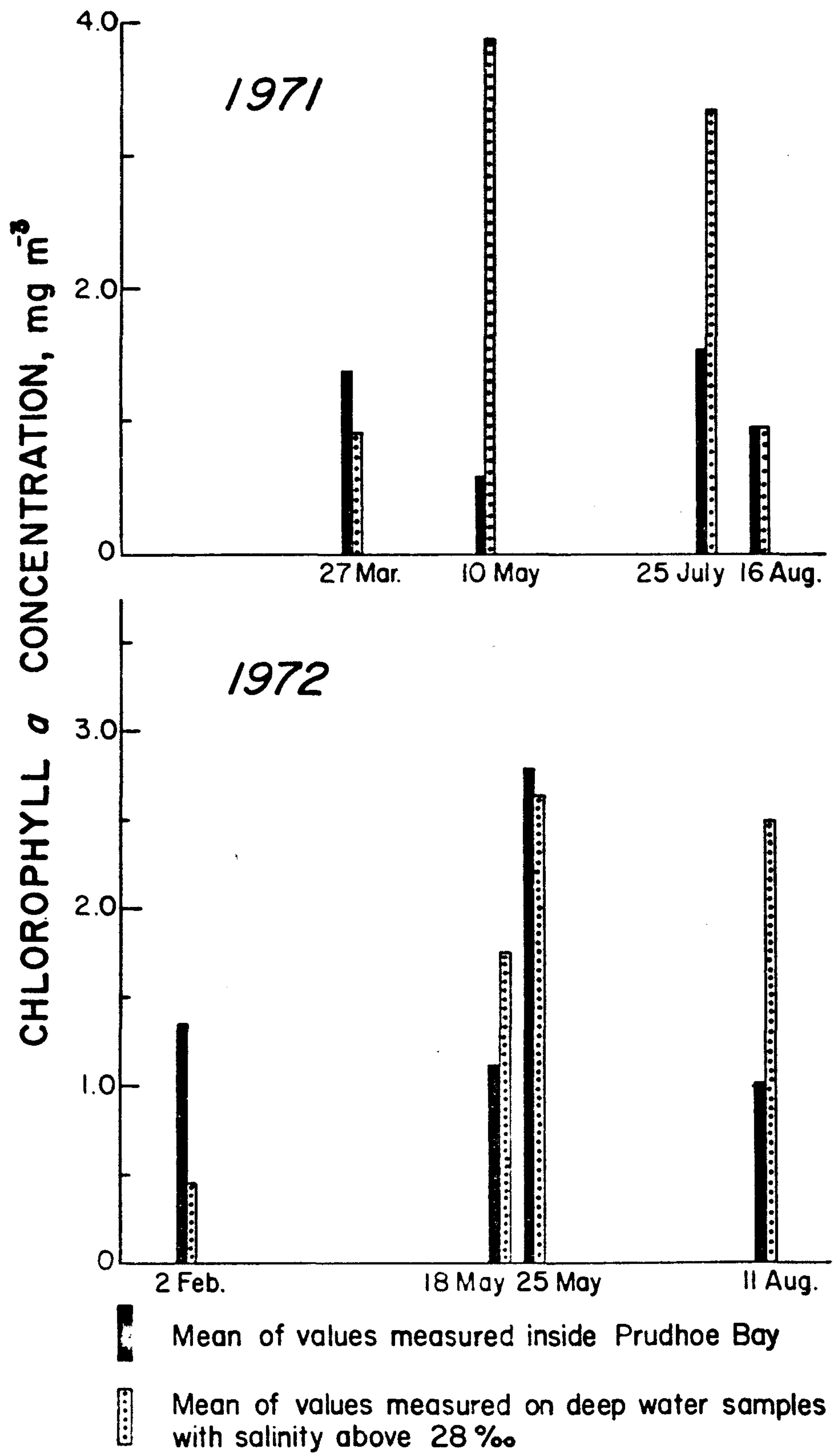
3.3.2 Water

Figure 5 shows the major trends in chlorophyll concentration in the water during 1971 and 1972. The highest recorded chlorophyll concentration during the winter and spring of 1971 occurred off Reindeer Island on 10 May (Table 8). Microscopic examination indicated that most of the algae in the water sample were also common in the ice (Appendix II, Tables 1 & 2). This was the case with all of the spring samples and may reflect the fact that they were dipped from a core hole in the ice. If the water samples had been collected from below the ice with a sampling bottle, the species composition of the ice and water samples might have been different. The species composition will be discussed in greater detail in section 3.6.

The chlorophyll concentration in the water both inside Prudhoe Bay and off Reindeer Island increased between 18 and 25 May 1972 (Fig. 5). The increase off Reindeer Island was probably caused by sloughing of ice algal cells from the bottom of the sea ice due to melting. During this period, the chlorophyll concentration in the bottom ice layer decreased by 2.7 mg m^{-3} (Table 8). Between 18 and 25 May the salinity of the water beneath the ice off Reindeer Island decreased (Table 4), further indicating that the ice was melting and releasing cells.

The increase in the chlorophyll concentration of the water inside Prudhoe Bay between 18 and 25 May was probably due to cell growth and production. During this period the chlorophyll concentration in the bottom ice increased by 17.5 mg m^{-3} (Table 8). The salinity of the water increased slightly (Table 4), thus giving no indication that the bottom ice was melting. The decrease in nitrate concentration

Fig. 5. Chlorophyll *a* concentration in mg m^{-3} recorded during 1971 and 1972. The values for 25 July and 15 August 1971, and for 11 August 1972 (Cruises I, II, and III, respectively) are the means of the data listed in Tables 9-11. The values for the other dates are the results of single determinations (Table 8). All measurements are on water samples.



CHLOROPHYLL a CONCENTRATION, mg m-3
1971
4.0
2.0
0
27 Mar.
10 May
25 July
16 Aug.
1972
3.0
2.0
1.0
0
2 Feb.
18 May
25 May
11 Aug.
Mean of values measured inside Prudhoe Bay
Mean of values measured on deep water samples with salinity above 28 ‰

Table 9. Chlorophyll *a* concentration in mg m^{-3} measured during Cruise I. All depths are in meters.

Inside Prudhoe Bay

Station Number	Sample Depth	Chl. *a* Conc.	Station Number	Sample Depth	Chl. *a* Conc.
PB 1	0	1.3	PB 6	1.5	2.9
PB 1	2.0	1.0	PB 7	1.5	1.7
PB 2	1.5	1.0	PB 8	1.5	3.6
PB 3	0.8	1.0	PB 9	1.5	1.6
PB 4	1.0	0.8	PB 10	0	1.5
PB 5	0	0.8	PB 11	0	1.6
PB 5	2.0	1.3			

Shallow brackish water outside Prudhoe Bay

Station Number	Sample Depth	Chl. *a* Conc.	Station Number	Sample Depth	Chl. *a* Conc.
PB 12	0	0.1	PB 17	0	0.2
PB 13	0	0.5	PB 18	0	0.4
PB 13	3.5	0.4	PB 18	4.5	0.4
PB 14	0	0.5	PB 19	0	0.3
PB 14	4.0	0.7	PB 20	1.5	0.6
PB 15	0	0.5	PB 21	1.0	1.4
PB 16	0	0.4	PB 22	1.5	0.5

Deep layer

Station Number	Sample Depth	Chl. *a* Conc.	Station Number	Sample Depth	Chl. *a* Conc.
PB 12	3.5	7.4	PB 17	6.0	1.2
PB 15	4.5	1.2	PB 19	5.5	0.8
PB 16	6.0	6.6			

Table 10. Chlorophyll *a* concentration in mg m^{-3} measured during Cruise II. All depths are in meters.

Inside Prudhoe Bay					
Station Number	Sample Depth	Chl. *a* Conc.	Station Number	Sample Depth	Chl. *a* Conc.
PB 112	1.0	1.0	PB 114	1.0	0.9
PB 113	1.0	1.2	PB 115	0	1.3

Shallow brackish water outside Prudhoe Bay					
Station Number	Sample Depth	Chl. *a* Conc.	Station Number	Sample Depth	Chl. *a* Conc.
PB 101	0	0.4	PB 110	0	0.7
PB 101	4.5	0.6	PB 110	4.5	0.7
PB 102	0	0.7	PB 111	1.5	0.6
PB 102	4.5	0.4	PB 116	0	0.9
PB 103	0	0.5	PB 117	0	0.3
PB 103	4.0	0.5	PB 117	3.5	0.5
PB 104	0	0.3	PB 118	0	0.6
PB 104	5.0	0.9	PB 119	0	0.5
PB 105	0	0.4	PB 120	0	0.5
PB 105	4.5	0.7	PB 121	0	0.6
PB 106	0	0.6	PB 122	0	0.6
PB 106	5.5	0.7	PB 123	0	0.4
PB 107	0	0.5	PB 124	0	0.5
PB 108	0	0.5	PB 125	1.5	0.5
PB 109	0	0.6			

Deep layer					
Station Number	Sample Depth	Chl. *a* Conc.	Station Number	Sample Depth	Chl. *a* Conc.
PB 107	9.5	0.7	PB 119	9.0	1.3
PB 108	6.5	0.7	PB 120	8.0	0.9

Intermediate layer (S°/₀₀ 22-28)					
Station Number	Sample Depth	Chl. *a* Conc.	Station Number	Sample Depth	Chl. *a* Conc.
PB 109	5.5	0.4	PB 122	7.5	0.5
PB 118	5.5	0.5	PB 123	4.5	0.3
PB 121	7.0	0.4	PB 124	6.5	1.0

Table 11. Chlorophyll *a* concentration in mg m^{-3} measured during Cruise III by the UNESCO and Lorenzen techniques. All depths are in meters.

Inside Prudhoe Bay

Station Number	Sample Depth	Chl. Conc UNESCO	Chl. Conc. Lorenzen
PB 201	1.0	0.7	0.8
Replicate		1.1	0.9
PB 202	1.0	1.0	0.9
Replicate		1.1	0.9
PB 203	1.3	1.1	1.4
Replicate		0.9	0.8
PB 204	1.0	2.6	0.5
Replicate		1.6	1.7
PB 205a	1.0	2.1	0.9
Replicate		1.4	1.2
PB 205b	1.0	1.3	1.0
Replicate		1.2	1.2
PB 206	1.0	0.6	0.2
Replicate		0.4	0.9
PB 207	1.0	0.7	1.0
Replicate		0.9	0.5
PB 208	1.0	0.7	0.6
Replicate		0.7	0.7
PB 209	1.0	0.4	0.9
Replicate		0.4	0.9

Shallow brackish water outside Prudhoe Bay

Station Number	Sample Depth	Chl. Conc. UNESCO	Chl. Conc. Lorenzen
PB 210	0	0.9	1.3
PB 212	0	0.9	1.6
PB 212	4.0	0.3	0.2
PB 213	0	0.6	0.8
PB 215	0	0.7	0.9
PB 216	0	0.6	0.2
PB 216	5.0	1.3	1.0
PB 217	0	1.1	1.7
PB 218	0	1.4	0.7
PB 218	4.0	1.3	0.9
PB 219	0	1.5	0.9
PB 219	5.0	0.9	1.0
PB 221	0	1.0	1.1
PB 223	1.0	1.6	1.3
Replicate		1.7	1.2
PB 224	0	1.0	1.4
Replicate		0.9	0.6
PB 225	0	0.9	1.0
Replicate		0.8	1.3
PB 227	0	1.8	1.4
Replicate		1.5	1.7

Deep layer

Station Number	Sample Depth	Chl. Conc. UNESCO	Chl. Conc. Lorenzen
PB 213	8.0	2.4	3.3
PB 215	8.0	3.8	5.3
PB 217	8.0	2.4	3.3

in the water between 18 and 25 May (Fig. 7) is further evidence that the increase in chlorophyll concentration inside Prudhoe Bay was due to algal productivity.

The highest chlorophyll concentration in the water occurred during Cruise I. The maximum value was 7.4 mg m^{-3} measured at 3.5 m depth at station PB 12. The chlorophyll concentration in the deep water layer was generally higher than that of the brackish surface water (Table 9), although high chlorophyll concentrations were observed at some of the brackish water stations inside Prudhoe Bay. A similar pattern was observed during Cruise III. No high chlorophyll values occurred at any of the shallow brackish water stations, but the deep water samples had an average chlorophyll concentration of 3.1 mg m^{-3} (Table 11). The chlorophyll concentration of the shallow water samples averaged 1 mg m^{-3}. No significant differences were observed in the chlorophyll concentration of the deep and shallow water during Cruise II (Table 10). In both water layers the average chlorophyll concentration was below 1 mg m^{-3}.

3.4 Primary Productivity

The primary productivity results are tabulated in Tables 12-14, and the means, standard deviations and variances of the data in these tables are listed in Table 15.

The highest primary productivity recorded during the Prudhoe Bay study (21.2 mg C m^{-3} hr^{-1}) occurred at 3.5 m depth at station PB 12, and this, along with the high ratio of nitrate to ammonia uptake

Table 12. Primary productivity in mg C m^{-3} hr^{-1} measured during Cruise I. The chlorophyll *a* concentration is in mg m^{-3}; all depths are in meters.

Inside Prudhoe Bay

Station Number	Sample Depth	Primary Prod.	Chl. *a* Conc.
PB 1	0	1.4	1.3
PB 1	2.0	2.3	1.0
PB 5	0	1.3	0.8
PB 5	2.0	8.0	1.3
PB 6	1.5	12.3	2.9
PB 8	1.5	6.5	3.6
PB 10	0	3.9	1.5

Shallow brackish water outside Prudhoe Bay

Station Number	Sample Depth	Primary Prod.	Chl. *a* Conc.
PB 12	0	0.4	0.2
PB 15	0	0.0	0.5
PB 22	1.5	0.2	0.5

Deep layer

Station Number	Sample Depth	Primary Prod.	Chl. *a* Conc.
PB 12	3.5	21.22	7.4
PB 15	4.5	1.8	1.2

Table 13. Primary productivity in mg C m^{-3} hr^{-1} measured during Cruise II. Chlorophyll *a* concentration is in mg m^{-3}; all depths are in meters.

Station Number	Sample Depth	Primary Prod.	Chl. *a* Conc.
Inside Prudhoe Bay			
PB 112	1.0	1.4	1.0
Shallow brackish water outside Prudhoe Bay			
PB 101	0	1.0	0.4
PB 101	4.5	0.6	0.6
PB 104	0	0.3	0.3
PB 104	5.0	0.7	0.9
PB 107	0	0.6	0.5
PB 117	0	0.2	0.3
PB 117	3.5	0.3	0.5
PB 119	0	0.1	0.5
PB 122	0	0.4	0.6
PB 122	7.5	0.4	0.6
PB 123	0	0.4	0.4
PB 123	4.5	0.4	0.3
Deep layer			
PB 107	9.5	1.3	0.7
PB 119	9.0	0.7	1.3

Table 14. Primary productivity in mg C m^{-3} hr^{-1} measured during Cruise III. Chlorophyll *a* concentration is in mg m^{-3}; all depths are in meters.

Inside Prudhoe Bay

Station Number	Sample Depth	Primary Prod.	Chl. *a* Conc.
PB 203	1.3	0.9	1.1
			0.9
PB 205b	1.0	0.9	1.3
			1.2
PB 206	1.0	0.4	0.6
			0.4
PB 208	1.0	0.4	0.7
			0.7

Shallow brackish water outside Prudhoe Bay

Station Number	Sample Depth	Primary Prod.	Chl. *a* Conc.
PB 210	0	1.0	0.9
PB 212	0	0.5	0.9
PB 212	4.0	0.4	0.3
PB 213	0	0.8	0.6
PB 217	0	1.0	1.1
PB 223	1.0	0.6	1.6
			1.7

Deep layer

Station Number	Sample Depth	Primary Prod.	Chl. *a* Conc.
PB 213	8.0	2.4	3.3
PB 217	5.0	2.1	1.4

Table 15. Mean, variance and standard deviation of the primary productivity measurements (mg C m^{-3} hr^{-1}) made during Cruises I-III.

Cruise I, data from Table 12

	n	Mean	Variance	S. D.
Inside Prudhoe Bay	7	5.1	16.6	4.1
Shallow water outside Prudhoe Bay	3	0.2	0.04	0.2
Deep high salinity layer	2	11.5	188.2	13.7

Cruise II, data from Table 13

	n	Mean	Variance	S. D.
Inside Prudhoe Bay	1	1.4	single determination	
Shallow water outside Prudhoe Bay	12	0.45	0.06	0.24
Deep high salinity layer	2	1.0	0.18	0.42

Cruise III, data from Table 14

	n	Mean	Variance	S. D.
Inside Prudhoe Bay	4	0.65	0.08	0.29
Shallow water outside Prudhoe Bay	6	0.71	0.07	0.26
Deep high salinity layer	2	2.3	0.05	0.21

rates (Table 24), high chlorophyll *a* concentration (Table 8), high salinity at 3.5 m depth (Table 5), and high phytoplankton standing stock (Table 21-B), indicates an area of upwelling. These conditions were not found during Cruises II and III. The only other primary productivity measurement done in the deep layer during Cruise I was 1.8 mg C m^{-3} hr^{-1} (415 m at station PB 15).

The primary productivity inside Prudhoe Bay during Cruise I was consistantly higher than that measured during the subsequent two cruises. The mean of seven values was 5.1 mg C m^{-3} hr^{-1} with a range of 1.4-12.3. The shallow lagoon water had very low productivity, with a mean of 0.2 mg C m^{-3} hr^{-1} and a range of 0.0-0.4 (Tables 12 and 15).

The highest primary productivity during Cruise II (1.4 mg C m^{-3} hr^{-1}) occurred at station PB 112, and was the only primary productivity measurement done inside Prudhoe Bay during this cruise. Two measurements were made on deep water giving values of 1.3 and 0.7 mg C m^{-3} hr^{-1} at stations PB 107 and PB 119 respectively; the remaining measurements were done on the shallow brackish water from the nearshore lagoons. The lagoon productivity was very low, with the mean of 10 values being 0.5 mg C m^{-3} hr^{-1} with a range of 0.1-1.0 (Tables 13 and 15).

During Cruise III the primary productivity inside Prudhoe Bay and in the shallow lagoon water outside the bay was consistantly below 1 mg C m^{-3} hr^{-1} (Table 14), with the surface value at PB 217

(1.1 mg C m^{-3} hr^{-1}) being the only exception. The mean of 10 measurements was 0.7 mg C m^{-3} hr^{-1} with a range of 0.4-1.1 mg C m^{-3} hr^{-1}. The highest primary productivity during Cruise III (2.4 mg C m^{-3} hr^{-1}) occurred at 8 m depth at station PB 213. This was the only primary productivity measurement done on the deep layer during the cruise. One measurement (2.1 mg C m^{-3} hr^{-1}) was done in intermediate water (salinity of 25.75°/₀₀) at 5 m depth from station PB 217, and this is included in the deep water section of Table 14 because its species composition was similar to that of the other deep water samples. These were the only values above 2 mg C m^{-3} hr^{-1} measured during the cruise.

3.5 Nutrient Concentration

3.5.1 Ice

The nutrient concentrations in the ice samples collected during the winter and spring of 1971 and 1972 are listed in Tables 16-17. Included beside each column is an average computed from the concentration in the top, middle and bottom sections of the core.

Phosphate and nitrite concentrations were very high in the top and middle ice layers during 1972 (Table 17) and the reason for this is not known. High phosphate and nitrite concentrations were not observed in the top and middle ice samples from Barrow (Horner 1972).

During the spring of 1972 the phosphate concentration in the bottom ice was usually lower than that of the top and middle ice (Table 17), and this may reflect phosphate utilization by the ice

Table 16. Phosphate, nitrate, nitrite, ammonia and silicate concentration in μg-atoms liter^{-1} measured during winter and spring of 1971.

Off Reindeer Island

		PO_4-P		NO_3-N		NO_2-N		NH_3-N		H_4SiO_4-Si	
	Top ice	0.2	ave.[1]	1.0	ave.	0.1	ave.	1.5	ave.	4.0	ave.
27	Middle ice	0.4	0.3	0.9	0.9	0.1	0.1	5.0	2.3	2.0	3.0
Mar.	Bottom ice	0.3		0.8		0.1		1.0		3.0	
	Water	1.3		3.7		0.1		3.2		17.0	
	Top ice	0.2	ave.	0.5	ave.	0.1	ave.			2.9	ave.
10	Middle ice	0.2	0.6	0.4	1.1	0.0	0.2			2.1	3.4
May	Bottom ice	1.3		2.4		0.4				5.2	
	Water	0.1		3.9		0.1				15.0	

Inside Prudhoe Bay

		PO_4-P		NO_3-N		NO_2-N		NH_3-N		H_4SiO_4-Si	
	Top ice	0.1	ave.	0.3	ave.	0.1	ave.	1.0	ave.	1.0	ave.
27	Middle ice	0.1	0.3	0.7	1.1	0.0	0.1	1.2	1.5	2.0	11.4
Mar.	Bottom ice	0.7		2.2		0.1		2.3		31.0	
	Water	0.8		9.4		0.1		7.9		35.0	
	Top ice	0.1	ave.	0.4	ave.	0.1	ave.			1.8	ave.
10	Middle ice	0.1	0.2	0.7	1.3	0.1	0.1			2.8	5.5
May	Bottom ice	0.3		2.7		0.1				11.8	
	Water	1.2		10.2		0.3				20.3	

[1] Average of the three ice values listed to the left. The water values are not included.

Table 17. Phosphate, nitrate, nitrite, ammonia and silicate concentration in μg-atoms liter^{-1} measured during winter and spring of 197[illegible].

Off Reindeer Island

Date	Sample	PO_4-P		NO_3-N		NO_2-N		NH_3-N		H_4SiO_4-Si	
2 Feb.	Top ice	0.2	ave.[1]	1.4	ave.	0.1	ave.	2.9	ave.	3.0	ave.
	Middle ice	0.2	0.2	1.3	1.3	0.1	0.1	6.4	4.1	3.0	3.0
	Bottom ice	0.2		1.1		0.1		3.4		2.0	
	Water	1.4		6.9		0.1		2.5		15.1	
18 May	Top ice	4.0	ave.	0.1	ave.	0.0	ave.	1.3	ave.	1.6	ave.
	Middle ice	2.0	2.1	0.4	0.3	0.0	0.0	1.3	1.4	2.1	1.6
	Bottom ice	0.2		0.3		0.0		1.6		1.1	
	Water	0.8		0.8		0.1		1.5		7.5	
25 May	Top ice	5.0	ave.	1.9	ave.	1.7	ave.	1.4	ave.	3.7	ave.
	Middle ice	2.1	2.4	0.4	0.9	1.0	0.9	1.4	1.5	1.5	2.1
	Bottom ice	0.1		0.3		0.0		1.6		1.2	
	Water	0.9		1.0		0.1		1.1		9.3	

Inside Prudhoe Bay

Date	Sample	PO_4-P		NO_3-N		NO_2-N		NH_3-N		H_4SiO_4-Si	
2 Feb.	Top ice	0.2	ave.	0.4	ave.	0.0	ave.	3.3	ave.	1.0	ave.
	Middle ice	0.2	0.2	0.5	1.1	0.1	0.1	4.2	4.1	0.9	1.3
	Bottom ice	0.1		2.5		0.1		4.7		2.1	
	Water	1.6		7.5		0.3		2.3		23.3	
18 May	Top ice	1.1	ave.	0.1	ave.	0.0	ave.	1.7	ave.	0.5	ave.
	Middle ice	0.2	0.5	0.0	0.4	0.2	0.3	1.3	1.7	0.5	2.2
	Bottom ice	0.2		1.2		0.6		2.2		5.5	
	Water	0.8		5.1		0.2		1.5		28.6	
25 May	Top ice	0.9	ave.	0.7	ave.	2.0	ave.	1.3	ave.	2.5	ave.
	Middle ice	2.1	1.1	1.1	1.0	2.2	1.4	1.4	1.6	2.9	3.9
	Bottom ice	0.4		1.2		0.0		2.0		6.3	
	Water	0.8		2.0		1.1		1.1		24.3	

[1] Average of the three ice values to the left. The water values are not included.

algae. The opposite trend occurred in the ice off Reindeer Island on 10 May 1971; the phosphate concentration was 0.2 μg-atoms PO_4-P liter^{-1} in the top and middle ice samples and 1.3 μg-atoms liter^{-1} in the bottom ice sample.

The highest silicate concentration in the ice occurred in the bottom layer inside Prudhoe Bay (Tables 16-17), the maximum values being 31.0 and 11.8 μg-atoms H_4SiO_4-Si liter^{-1} measured on 27 March and 10 May 1971, respectively. In 1972 the silicate concentration in the bottom ice in Prudhoe Bay was lower (5.5 and 6.3 μg-atoms H_4SiO_4-Si liter^{-1} on 18 and 25 May) and this may reflect silicate utilization by the ice algae. The high silicate levels in the bottom ice in Prudhoe Bay may have been caused by diffusion of silicate into the ice from the water, which had very high silicate concentrations (Tables 16-17). The silicate concentrations in the bottom ice off Reindeer Island were lower (1.1 and 1.2 μg-atoms H_4SiO_4-Si liter^{-1} on 18 and 25 May respectively) and this may reflect lower silicate concentrations in the water beneath the ice, and silicate uptake by diatoms. The silicate concentration in the top and middle ice layers ranged from 1.0-3.0 μg-atoms H_4SiO_4-Si liter^{-1} and showed no apparent pattern.

The lowest nitrate concentrations occurred in the bottom ice off Reindeer Island on 18 and 25 May 1972 (0.3 μg-atoms NO_3-N liter^{-1} on both dates). The bottom ice value for the same dates in Prudhoe Bay was 1.2 μg-atoms NO_3-N liter^{-1}. The nitrate concentration in the top and middle ice ranged from 0.0-1.9 μg-atoms liter^{-1} with no consistant pattern of variation. The average ammonia concentration in the ice during 1972 was lower in May than in February, both in the bay and off Reindeer Island, and this could be due to ammonia uptake by ice algae. These observations are from only five samplings in two years and may not accurately reflect the major annual trends in nutrient concentration.

3.5.2 Water

The nutrient concentrations measured in the water during winter and spring are included in Tables 16 and 17, and the nutrient results from Cruises I-III are listed in Tables 18-20.

The highest nitrate concentration in the water occurred inside Prudhoe Bay during winter and spring (Fig. 6-7). Maximum concentration during 1971 and 1972 was 10.2 and 7.5 μg-atoms NO_3-N liter^{-1} respectively. The nitrate concentration during 1971 showed an increase from 9.4 to 10.2 μg-atoms NO_3-N liter^{-1} between 27 March and 10 May. The opposite trend was observed during 1972, the nitrate concentration being 7.5 μg-atoms liter^{-1} on 2 February and 5.1 μg-atoms liter^{-1} on 18 May. The lower value on 18 May was probably caused by nitrate assimilation due to increasing primary productivity as the spring bloom began. The concentration subsequently fell to 2.0 μg-atoms NO_3-N liter^{-1} by 25 May, and this, coupled with an increase in chlorophyll *a* concentration (Table 8), indicates rapid utilization of the available nitrate by the autotrophs.

Table 18. Phosphate, nitrate, nitrite, ammonia and silicate concentration in µg-atoms liter^{-1} measured during Cruise I. All depths are in meters.

Inside Prudhoe Bay

Station Number	Sample Depth	PO_4-P	NO_3-N	NO_2-N	NH_3-N	H_4SiO_4-Si
PB 1	0	0.4	0.4	0.1	2.7	
PB 1	2.0	0.4	0.4	0.1	1.4	12.0
PB 2	1.5	0.4	0.3	0.1	1.4	13.5
PB 3	0.8	0.4	0.4	0.1	1.7	15.0
PB 4	1.0	0.2	0.8	0.1	1.6	17.3
PB 5	0	0.2	0.4	0.1	1.4	13.6
PB 5	2.0	0.2	0.2	0.1	1.6	8.5
PB 6	1.5	0.3	0.4	0.1	1.6	13.0
PB 7	1.5	0.3	0.3	0.1	1.5	14.7
PB 8	1.5	0.3	0.3	0.1	1.8	14.7
PB 9	1.5	0.1	2.7	0.1		27.0
PB 10	0	0.2	2.7	0.1		28.3
PB 11	0	0.1	2.2	0.1		25.8

Deep layer

Station Number	Sample Depth	PO_4-P	NO_3-N	NO_2-N	H_4SiO_4-Si
PB 12	3.5	0.8	0.1	0.1	6.8
PB 15	4.5	0.7	0.0	0.1	7.0
PB 16	6.0	0.9	0.1	0.1	6.5
PB 17	6.0	0.9	0.1	0.1	5.4
PB 19	5.5	0.7	0.0	0.1	5.4

Shallow brackish layer outside Prudhoe Bay

Station Number	Sample Depth	PO_4-P	NO_3-N	NO_2-N	H_4SiO_4-Si
PB 12	0	0.5	0.0	0.1	6.1
PB 13	0	0.4	0.1	0.1	5.8
PB 13	3.5	0.6	0.0	0.1	6.2
PB 14	0	0.5	0.1	0.1	6.2
PB 14	4.0	0.7	0.0	0.1	7.1
PB 15	0	0.3	0.2	0.1	6.2
PB 16	0	0.8	0.3	0.1	5.7
PB 17	0	0.5	0.2	0.0	5.0
PB 18	0	0.6	0.1	0.1	6.3
PB 18	4.5	0.7	0.1	0.1	6.1
PB 19	0	0.5	0.1	0.1	6.0
PB 20	1.5	0.7	0.1	0.1	7.0
PB 21	1.0	0.5	0.1	0.1	7.4
PB 22	1.5	0.7	0.1	0.1	6.2

Table 19. Phosphate, nitrate, nitrite and silicate concentration in μg-atoms liter^{-1} measured during Cruise II. All depths are in meters.

Inside Prudhoe Bay

Station Number	Sample Depth	PO_4-P	NO_3-N	NO_2-N	H_4SiO_4-Si
PB 112	1.0	0.1	0.2	0.1	16.4
PB 113	1.0	0.1	0.2	0.1	11.4
PB 114	1.0	0.1	0.2	0.1	16.3
PB 115	0	0.2	0.2	0.1	12.8

Shallow brackish layer outside Prudhoe Bay

Station Number	Sample Depth	PO_4-P	NO_3-N	NO_2-N	H_4SiO_4-Si
PB 101	0	0.3	0.1	0.1	7.1
PB 101	4.5	0.3	0.1	0.1	5.8
PB 102	0	0.4	0.1	0.1	7.5
PB 102	4.5	0.3	0.1	0.1	7.5
PB 103	0	0.3	0.1	0.1	7.4
PB 103	4.0	0.3	0.1	0.1	7.7
PB 104	0	0.4	0.1	0.1	7.5
PB 104	5.0	0.6	0.1	0.1	8.2
PB 105	0	0.3	0.0	0.1	6.0
PB 105	4.5	0.4	0.1	0.1	7.6
PB 106	0	0.3	0.2	0.0	6.2
PB 106	5.5	0.4	0.1	0.1	7.1
PB 107	0	0.3	0.1	0.1	6.1
PB 108	0	0.2	0.1	0.1	7.1
PB 109	0	0.3	0.1	0.1	8.6
PB 110	0	0.3	0.1	0.1	9.3
PB 110	4.5	0.2	0.1	0.1	4.8
PB 111	1.5	0.2	0.2	0.1	1.0
PB 116	0	0.3	0.2	0.1	10.2
PB 117	0	0.3	0.2	0.1	5.0
PB 117	3.5	0.5	0.1	0.1	5.5
PB 118	0	0.4	0.2	0.1	4.6
PB 119	0	0.4	0.2	0.1	0.5
PB 120	0	0.4	0.2	0.1	5.9
PB 121	0	0.4	0.2	0.1	6.5
PB 122	0	0.4	0.1	0.1	5.5
PB 123	0	0.3	0.0	0.1	6.8
PB 124	0	0.3	0.1	0.1	7.6
PB 125	1.5	0.4	0.0	0.1	7.1

Deep layer

Station Number	Sample Depth	PO_4-P	NO_3-N	NO_2-N	H_4SiO_4-Si
PB 107	9.5	0.8	0.2	0.1	7.5
PB 108	6.5	0.7	0.1	0.1	6.5
PB 119	9.0	0.8	0.2	0.1	4.5
PB 120	8.0	0.8	0.2	0.1	5.7

Table 20. Phosphate, nitrate, nitrite, ammonia and silicate concentration in µg-atoms liter^{-1} measured during Cruise III. All depths are in meters. The nitrate and nitrite concentrations are summed and listed in a single column.

Inside Prudhoe Bay

Station Number	Sample Depth	PO_4-P	NO_3-N+ NO_2-N	NH_3-N	H_4SiO_4-Si
PB 201	1.0	0.4	0.3	0.6	9.0
PB 202	1.0	0.4	0.1	0.3	7.7
PB 203	1.3	0.4	0.3	0.3	8.8
PB 204	1.0	0.3	0.3	0.9	9.5
PB 205a	1.0	0.5	0.4	1.5	11.0
PB 205b	1.0	0.3	0.8	0.9	16.9
PB 206	1.0	0.3	0.3	1.7	10.1
PB 207	1.0	0.4	0.1	0.2	7.7
PB 208	1.0	0.5	0.4	0.6	9.3
PB 209	1.0	0.6	0.3	0.7	9.6

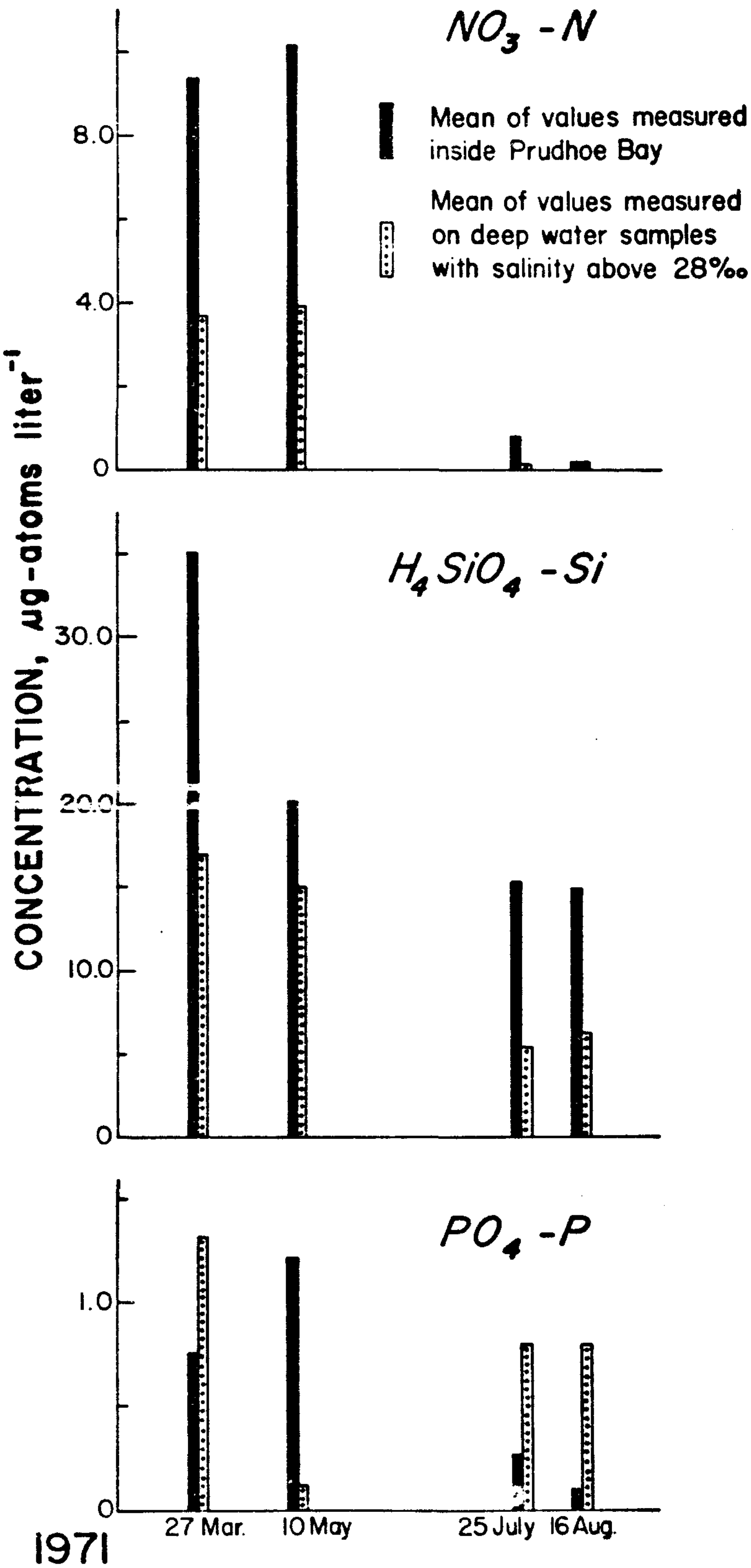
Shallow brackish water outside Prudhoe Bay

Station Number	Sample Depth	PO_4-P	NO_3-N+ NO_2-N	NH_3-N	H_4SiO_4-Si
PB 210	0	0.4	0.5	1.3	10.3
PB 212	0	0.5	0.6	4.1	7.8
PB 212	4.0	0.4	0.3	0.4	6.8
PB 213	0	0.5	0.3	0.0	7.0
PB 215	0	0.5	0.3	0.7	7.1
PB 216	0	0.5	0.5	1.1	9.3
PB 216	5.0	0.6	0.3	0.7	9.0
PB 217	0	0.5	0.3	0.7	8.7
PB 218	0	0.4	0.4	0.6	9.5
PB 218	4.0	0.4	0.3	0.7	9.7
PB 219	0	0.6	0.2	0.7	9.0
PB 219	5.0	0.5	0.3	0.6	8.1
PB 221	0	0.4	0.4	0.9	9.6
PB 223	1.0	0.2	0.6	0.5	11.0
PB 224	0	0.3	0.2	0.2	9.2
PB 225	0	0.4	0.5	1.2	8.5
PB 227	0	0.3	0.4	0.5	10.6

Deep layer

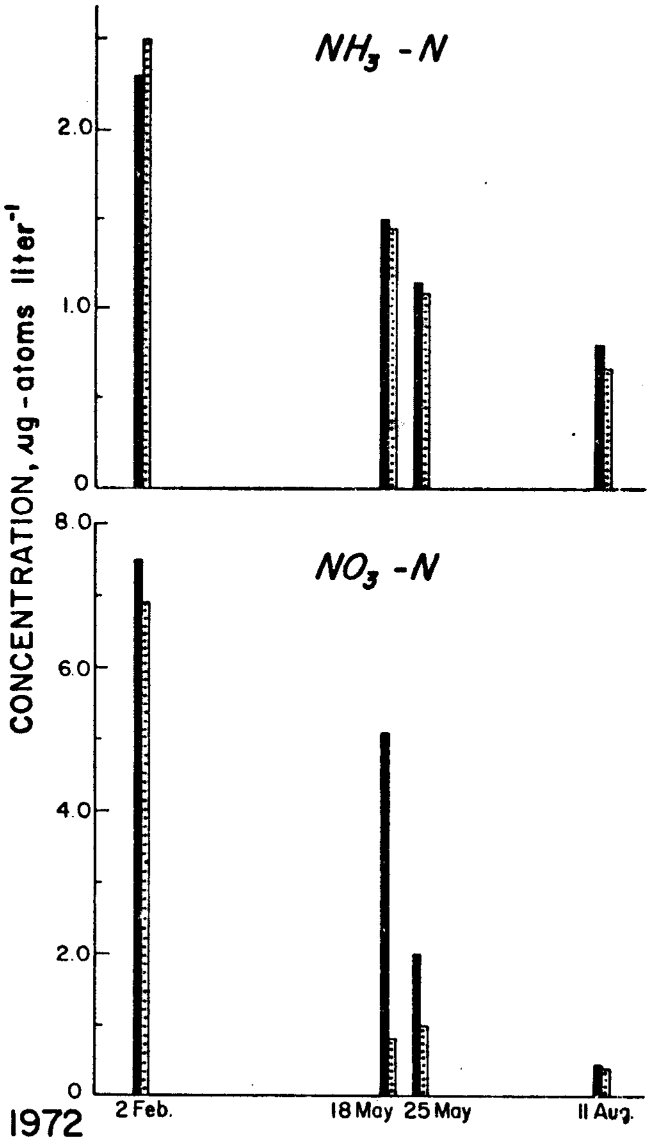
Station Number	Sample Depth	PO_4-P	NO_3-N+ NO_2-N	NH_3-N	H_4SiO_4-Si
PB 213	810	015	0.3	0.0	7.0
PB 215	8.0	0.5	0.3	0.7	7.1
PB 217	5.0	0.6	0.4	0.8	6.4

Fig. 6. Nutrient concentration in μg-atoms liter^{-1} measured in the deep layer and in the shallow water inside Prudhoe Bay during 1971. The values for 25 July and 16 August (Cruise I and II, respectively) are means of the data listed in Tables 18 and 19. The values for 27 March and 10 May are the results of single determinations (Table 16).

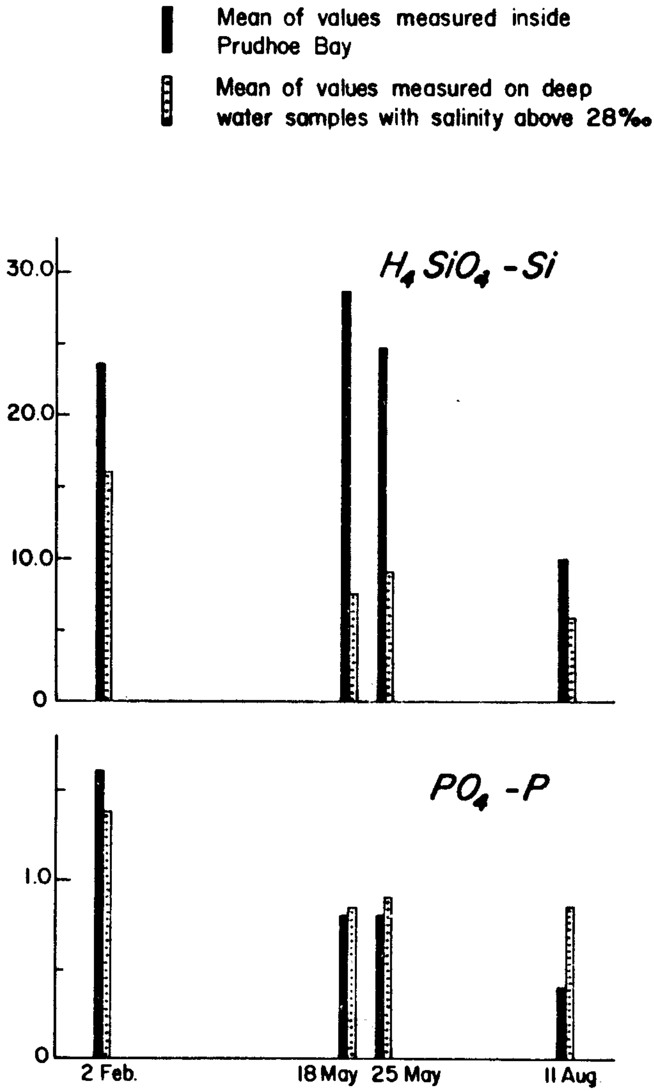


NO3 -N
Mean of values measured inside Prudhoe Bay
Mean of values measured on deep water samples with salinity above 28‰
8.0
4.0
0
H4SiO4 -Si
30.0
20.0
10.0
0
PO4 -P
1.0
0
CONCENTRATION, μg-atoms liter⁻¹
27 Mar.
10 May
25 July
16 Aug.
1971

Fig. 7. Nutrient concentration in μg-atoms liter^{-1} measured in the deep water layer and in the shallow water inside Prudhoe Bay during 1972. The values for 11 August (Cruise III) are means of the data listed in Table 20. The values for the other three dates are the results of single determinations (Table 17).



NH_3 -N
NO_3 -N
CONCENTRATION, µg-atoms liter^{-1}
2.0
1.0
0
8.0
6.0
4.0
2.0
0
1972
2 Feb.
18 May
25 May
11 Aug.



Mean of values measured inside Prudhoe Bay
Mean of values measured on deep water samples with salinity above 28‰
H_4SiO_4 -Si
30.0
20.0
10.0
0
PO_4 -P
1.0
0
2 Feb.
18 May
25 May
11 Aug

The nitrate concentration in the water off Reindeer Island during the spring of 1971 was 3.7 μg-atoms NO_3-N liter^{-1} on 27 March and 3.9 μg-atoms liter^{-1} on 10 May. The 1972 data showed a large drop, from the highest recorded value of 6.9 μg-atoms NO_3-N liter^{-1} on 2 February, to 0.8 μg-atoms liter^{-1} on 18 May and 1.0 μg-atoms liter^{-1} on 25 May. This is further indication that the spring bloom off Reindeer Island occurred earlier than 18 May (section 3.3).

Nitrate concentration during all three cruises was below 1 μg-atom NO_3-N liter^{-1}, except at stations PB 9-11, where it was 2.7, 2.7 and 2.2 μg-atoms liter^{-1} respectively (Table 18). This may be due to high nitrate concentrations in the Sagavanirktok River water. Schell (Kinney et al. 1972) reported high nitrate concentrations in the Colville River. The salinity at these stations was 6.86, 5.46 and 11.64‰, about half that normally encountered in Prudhoe Bay and lagoon surface water (Tables 5-7). With these stations excluded, the average nitrate level in Prudhoe Bay during Cruise I was 0.4 μg-atoms NO_3-N liter^{-1}, and in lagoon surface water and deep water it averaged 0.1 μg-atoms liter^{-1}. Nitrate concentration in the deep water and in Prudhoe Bay during Cruise II averaged 0.2 μg-atoms liter^{-1}, and in the lagoon surface water it averaged 0.1 μg-atoms liter^{-1}. The average nitrate concentration for Prudhoe Bay, lagoon surface water, and deep water was 0.4 μg-atoms NO_3-N liter^{-1} during Cruise III. These averages are computed from the data listed in Tables 18-20.

Ammonia data are available for the 1972 sampling season only. The maximum ammonia concentration, measured on 2 February, was 2.3 μg-atoms NH_3-N liter^{-1} in Prudhoe Bay and 2.5 μg-atoms liter^{-1} off Reindeer Island. The spring values for both sites are somewhat lower, having fallen to 1.5 μg-atoms NH_3-N liter^{-1} on 18 May and 1.1 μg-atoms liter^{-1} on 25 May. The average ammonia concentration during Cruise III was 0.8 and 0.7 μg-atoms NH_3-N liter^{-1} in the bay and deep water respectively.

Phosphate concentration seemed to vary irregularly throughout the year. During 1971 the phosphate concentration off Reindeer Island fell from 1.3 μg-atoms PO_4-P liter^{-1} on 27 March to 0.1 μg-atoms liter^{-1} on 10 May, and this may have been due to the intense ice algal bloom which was occurring there in early May. During the corresponding period the phosphate concentration inside Prudhoe Bay rose from 0.8 to 1.2 μg-atoms PO_4-P liter^{-1}, thus indicating that no spring bloom had occurred in the bay by 10 May. The summer phosphate concentration was lower in Prudhoe Bay than in the deep lagoon water, averaging 0.3 and 0.1 μg-atoms PO_4-P liter^{-1} during Cruises I and II respectively, and 0.8 μg-atoms liter^{-1} in the deep water during both of the above cruises. The highest phosphate concentrations recorded during 1972 (1.6 and 1.4 μg-atoms PO_4-P liter^{-1} in Prudhoe Bay and off Reindeer Island respectively) occurred on 2 February. By May the phosphate concentration at both sites had dropped to 0.8 μg-atoms PO_4-P liter^{-1}. During Cruise III the deep water phosphate concentration again averaged 0.8 μg-atoms liter^{-1}, while the shallow water concentration was lower, averaging 0.4 μg-atoms liter^{-1}.

Maximum silicate concentration during 1971 (35.0 μg-atoms H_4SiO_4-Si liter^{-1}) occurred inside Prudhoe Bay on 27 March. It subsequently dropped to 20.3 μg-atoms liter^{-1} by 10 May, and the reason for the drop is not known, as there was no other evidence of a diatom bloom having occurred in Prudhoe Bay during this time period. The values from the sampling station off Reindeer Island were 17.0 and 15.0 μg-atoms H_4SiO_4-Si liter^{-1} for 27 March and 10 May respectively. The average silicate concentration in Prudhoe Bay during Cruises I and II was 16.2 and 14.7 μg-atoms H_4SiO_4-Si liter^{-1} respectively. The deep water values for the same cruises were 6.2 and 6.1 μg-atoms liter^{-1}.

The silicate concentration inside Prudhoe Bay on 2 February 1972, was 23.3 μg-atoms H_4SiO_4-Si liter^{-1}, and the value for the same date off Reindeer Island was 15.1 μg-atoms liter^{-1}. The highest recorded silicate concentration (28.6 μg-atoms H_4SiO_4-Si liter^{-1}) occurred inside Prudhoe Bay on 18 May, and it subsequently fell, perhaps due to initiation of the spring bloom, to 24.3 μg-atoms liter^{-1} by 25 May. The corresponding values off Reindeer Island were 7.5 and 9.3 μg-atoms H_4SiO_4-Si liter^{-1} on 18 and 25 May respectively. The average silicate concentration in Prudhoe Bay and in the deep water during Cruise III was 10.0 and 5.9 μg-atoms H_4SiO_4-Si liter^{-1} respectively.

3.6 Community Composition

Summary sheets containing the phytoplankton standing stock data for each sample are compiled in Appendix II. Each sheet contains a list of the species, followed by the number of cells of each species per liter. In addition, the percentage composition of the dominant algal forms collected during each of the three cruises is listed in Tables 21-23.

During spring sampling pennate diatoms were the dominant algae both in the bottom ice and in the water just below the ice. The highest cell concentration occurred in the bottom ice off Reindeer Island on 10 May 1971. There were 83 million cells per liter, 97% of which were pennate diatoms with *Fragilariopsis* spp. being dominant. The apical axis of the *Fragilariopsis* spp. was 12-70 μm long, and they made up 79% of the total number of cells. *Nitzschia frigida* Grunow was also abundant, comprising 10% of the total number of cells. Other species present were *Cylindrotheca closterium*, *Navicula directa* W. Smith, *Navicula valida* Cleve and Grunow, *Gomphonema exiguum* Kützing, and *Gyro-Pleurosigma* spp.; 5.3% of the diatoms were unidentified forms whose apical axes were 18-300 μm long. The water sample from beneath the ice had the same general species composition, but contained only 7.9 million cells per liter.

Sampling during the spring of 1972 was done on 18 and 25 May and seems to have been after the major diatom bloom in the ice off Reindeer Island. There were 180 and 494 thousand cells per liter

Table 21 A. Percentage composition and total number of cells of the dominant algal forms from inside Prudhoe Bay during Cruise 1. The total number of individuals, followed by their percentage composition, is listed for each sample in columns A-F. The total number of individuals is obtained by multiplying the numbers in the columns by 1000. All depths are in meters.

Station Number	Sample Depth	A	B	C	D	E	F
PB 6	1.5	90.8	54.8	0.4	28.8	54.8	28.8
			60.4%	0.4%	31.7%	60.4%	31.7%
PB 7	1.5	42.8	30.4	0.8	4.4	28.8	0.4
			71.0%	1.9%	10.3%	67.3%	0.9%
PB 8	1.5	108.0	72.2	0.4	5.6	73.6	3.6
			71.5%	0.4%	5.2%	68.1%	3.3%
PB 9	1.5	26.4	16.4	0.0	9.6	16.4	5.2
			62.1%		36.4%	62.1%	19.7%
PB 10	0	83.1	43.1	0.0	3.2	42.3	0.0
			51.9%		3.9%	50.9%	
PB 11	0	46.6	27.4	0.0	2.8	25.8	0.0
			58.8%		6.0%	55.6%	

A = total number of cells per liter.
B = total number of diatoms per liter.
C = total number of dinoflagellates per liter.
D = total number of flagellates per liter.
E = total number of pennate diatoms per liter.
F = total number of euglenoid cells per liter.

Table 21 B. Percentage composition and total number of cells per liter of the dominant algal forms from the deep layer during Cruise I. The total number of individuals, followed by their percentage composition, is listed for each sample in columns A-H. The total number of individuals per liter is obtained by multiplying the numbers in the columns by 1000. All depths are in meters.

Station Number	Sample Depth	A	B	C	D	E	F	G	H
PB 12	3.5	987.2	823.6 83.4%	8.0 0.8%	48.4 4.9%	292.0 29.6%	388.8 39.4%	26.8 2.7%	531.6 53.8%
PB 16	6.0	1626.8	1597.9 98.2%	8.4 0.5%	10.2 0.6%	85.2 5.2%	241.2 14.8%	1238.4 76.1%	1512.7 92.9%
PB 17	6.0	298.0	205.1 68.8%	10.0 3.4%	24.4 8.2%	108.8 36.5%	45.2 15.2%	10.0 3.4%	96.8 32.5%
PB 19	5.5	124.7	35.2 28.2%	4.8 3.9%	39.5 31.6%	4.0 3.2%	7.6 6.1%	12.8 10.3%	31.2 25.0%

A = total number of cells per liter.
B = total number of diatom cells per liter.
C = total number of dinoflagellate cells per liter.
D = total number of flagellate cells per liter.
E = total number of pennate diatoms per liter.
F = total number of *Thalassiosira nordenskiöldii* per liter.
G = total number of *Chaetoceros socialis* per liter.
H = total number of centric diatoms per liter.

Table 21 C. Percentage composition and total number of cells of the dominant algal forms from the shallow brackish water layer outside Prudhoe Bay during Cruise I. The total number of individuals, followed by their percentage composition, is listed for each sample in columns A-I. The total number of individuals per liter is obtained by multiplying the numbers in the columns by 1000. All depths are in meters.

Station Number	Sample Depth	A	B	C	D	E	F	G	H	I
PB 12	0	193.2	13.6	2.0	104.4	12.8	55.2	7.6	0.8	26.0
			7.0%	1.0%	54.0%	6.6%	28.6%	3.9%	0.4%	21.5%
PB 13	0	76.1	9.6	3.6	29.7	6.4	10.8	1.6	3.2	16.9
			12.6%	4.7%	39.0%	8.4%	14.2%	2.1%	4.2%	22.2%
PB 13	3.5	92.4	12.0	2.8	47.2	4.0	0.8	16.0	8.0	30.4
			13.0%	3.0%	51.1%	4.3%	0.9%	17.3%	8.7%	32.9%
PB 14	0	164.1	14.0	6.4	72.0	7.2	10.0	6.0	6.8	56.0
			8.5%	3.9%	23.9%	4.4%	6.1%	3.7%	4.1%	34.1%
PB 19	0	172.8	9.2	1.6	133.2	4.0	64.0	2.4	5.2	64.8
			5.3%	0.9%	77.1%	2.3%	37.0%	1.4%	3.0%	37.5%
PB 20	1.5	114.8	12.0	2.4	49.6	5.6	17.6	4.4	6.4	27.6
			9.6%	2.1%	43.2%	4.9%	15.3%	3.8%	5.6%	24.0%
PB 21	1.0	113.6	33.2	2.0	29.6	30.0	8.4	2.0	3.2	19.2
			29.2%	1.8%	26.1%	26.4%	7.4%	1.8%	2.8%	16.9%
PB 22	1.5	102.8	18.0	2.8	54.4	6.0	16.0	2.8	12.0	32.8
			17.5%	2.7%	52.9%	5.8%	15.6%	2.7%	11.7%	31.9%

A = total number of cells per liter.
B = total number of diatoms per liter.
C = total number of dinoflagellates per liter.
D = total number of flagellates per liter.
E = total number of pennate diatoms per liter.
F = total number of *Dinobryon balticum* per liter.
G = total number of *Platymonas* sp. per liter.
H = total number of centric diatoms per liter.
I = total number of unidentified flagellates per liter.

Table 22. Percentage composition and total number of cells of the dominant algal forms in the Cruise II samples. The total number of individuals, followed by their percentage composition, is listed for each of the samples in columns A-I. The total number of individuals per liter is obtained by multiplying the numbers in the columns by 1000. All depths are in meters.

Station Number	Sample Depth	A	B	C	D	E	F	G	H	I
PB 101	0	180.0	14.4 7.9%	4.0 2.2%	91.2 50.7%	20.8 11.[illegible]%	14.0 7.7%	4.4 2.4%	0.0	46.4 25.8%
PB 101	4.5	210.8	10.8 5.1%	1.2 0.5%	144.8 68.7%	12.4 5.9%	24.8 11.7%	11.6 5.5%	22.4 10.6%	69.2 32.8%
PB 102	4.5	196.4	5.6 2.9%	0.8 0.4%	114.8 58.8%	16.4 8.4%	12.4 6.3%	24.8 12.6%	10.8 5.5%	48.0 24.4%
PB 103	0	224.5	3.2 1.4%	2.0 0.9%	158.8 70.7%	0.8 0.4%	25.2 11.2%	36.0 16.0%	28.8 12.8%	64.0 28.5%
PB 103	4.0	230.8	2.4 1.0%	1.6 0.7%	134.8 58.4%	4.8 2.1%	21.2 9.2%	30.4 13.2%	13.6 5.9%	60.4 26.2%
PB 104	3.0	171.2	3.2 1.9%	2.0 1.2%	106.0 61.9%	12.0 7.0%	0.0	8.4 4.9%	15.2 8.9%	63.2 36.9%
PB 105	0	173.2	1.2 0.7%	3.2 1.8%	119.6 69.1%	8.8 5.1%	20.8 12.0%	7.6 4.4%	6.0 3.5%	70.8 40.9%
PB 106	0	246.0	5.2 2.1%	1.6 0.7%	169.6 68.9%	29.2 11.9%	10.0 4.1%	20.8 8.5%	4.4 1.8%	101.6 41.3%
PB 107	5.0	141.4	2.4 1.7%	0.8 0.6%	106.6 75.4%	10.8 7.6%	14.4 10.2%	10.0 7.1%	0.0	65.4 46.3%
PB 108	3.5	170.8	3.6 2.1%	0.8 0.5%	133.2 80.0%	37.6 22.0%	24.8 14.5%	4.4 2.6%	36.8 21.5%	26.8 15.7%
PB 109	0	170.2	1.6 0.9%	1.6 0.9%	106.6 62.3%	14.8 8.7%	22.4 13.2%	1.6 0.9%	16.0 9.4%	48.4 28.4%
PB 110	0	194.8	1.6 0.8%	2.8 1.4%	144.4 74.1%	46.0 23.6%	64.0 32.9%	2.8 1.4%	6.0 3.1%	75.2 38.6%
PB 110	4.5	214.7	2.8 1.3%	2.8 1.3%	143.6 66.9%	15.6 7.3%	24.4 11.4%	22.0 10.2%	10.0 4.7%	66.4 30.9%
PB 112	1.0	182.8	6.0 3.3%	1.2 0.7%	82.0 44.9%	4.8 2.6%	0.0	4.4 2.4%	0.0	67.2 36.8%
PB 113	1.0	189.2	2.8 1.5%	0.4 0.2%	56.0 29.6%	6.4 3.4%	0.8 0.4%	3.6 1.9%	2.0 1.1%	35.2 18.6%
PB 114	1.0	201.6	4.0 2.0%	2.0 1.0%	83.2 41.3%	12.4 6.2%	1.2 0.6%	6.4 3.2%	1.6 0.8%	58.4 29.0%
PB 117	2.0	232.8	6.4 2.8%	2.0 0.9%	200.8 86.3%	10.8 4.6%	39.6 17.0%	58.4 25.1%	16.8 7.2%	68.4 27.8%
PB 118	0	305.7	7.6 2.5%	1.3 0.4%	231.2 79.6%	15.6 5.1%	24.0 7.8%	28.8 9.4%	27.2 8.9%	127.6 41.7%
PB 118	5.5	417.0	4.0 1.0%	1.8 0.4%	340.8 81.7%	12.4 3.0%	16.8 4.0%	202.4 48.5%	6.4 1.5%	99.6 23.9%
PB 119	5.0	326.4	5.4 1.7%	2.0 0.6%	276.2 84.6%	16.0 4.9%	24.4 7.5%	133.2 40.8%	14.4 4.4%	84.2 25.8%
PB 120	0	144.7	0.8 0.6%	1.0 0.7%	112.4 77.7%	10.4 7.2%	62.0 42.8%	4.0 2.8%	8.8 6.1%	24.4 16.9%
PB 120[1]	8.0	252.6	51.6 20.4%	3.6 1.4%	152.0 60.2%	0.0	11.2 4.4%	93.2 36.9%	1.2 0.5%	43.6 17.3%
PB 121	0	266.8	3.2 1.2%	2.1 0.9%	193.6 72.6%	18.8 7.1%	76.4 28.6%	2.4 o.9%	29.2 10.9%	58.4 21.9%
PB 121[2]	7.0	208.3	12.4 6.0%	0.3 0.1%	162.0 77.8%	1.2 0.6%	4.8 2.3%	90.4 43.4%	0.0	62.0 29.8%
PB 122	4.0	380.0	4.4 1.2%	1.6 0.4%	352.0 92.6%	63.6 16.7%	54.4 14.3%	118.4 31.2%	23.2 6.1%	85.2 22.4%
PB 123	2.0	338.7	2.0 0.6%	2.1 0.6%	284.8 84.1%	19.2 5.7%	106.4 31.4%	36.8 10.9%	22.8 6.7%	92.4 27.3%

A = total number of cells per liter.
B = total number of diatoms per liter.
C = total number of dinoflagellates per liter.
D = total number of flagellates per liter.
E = total number of [illegible] per liter.
F = total number of [illegible] per liter.
G = total number of [illegible] per liter.
H = total number of *Calycomonas [illegible]* per liter.
I = total number of unidentified flagellates per liter.

[1] Salinity at this station was 30.3‰.

[2] Salinity at this station was 25.9‰.

Table 23 A. Percentage composition and total number of cells of the dominant algal forms from inside Prudhoe Bay during Cruise III. The total number of individuals, followed by their percentage composition, is listed for each of the samples in columns A-H. The total number of individuals is obtained by multiplying the numbers in the columns by 1000. All depths are in meters.

Station Number	Sample Depth	A	B	C	D	E	F	G	H
PB 203	1.5	220.2	39.0 18.0%	1.3 0.3%	145.8 66.2%	93.0 42.0%	22.8 10.3%	0.6 0.3%	25.8 11.7%
PB 205b	1.5	289.2	11.4 5.0%	0.5 0.2%	253.8 88.0%	196.2 68.0%	9.0 3.0%	3.6 1.2%	43.2 14.9%
PB 206	2.0	349.6	5.6 1.6%	0.0	316.8 91.0%	188.0 54.0%	44.4 12.7%	2.0 0.6%	75.2 21.5%
PB 208	1.5	444.9	23.6 5.3%	0.8 0.2%	407.7 92.0%	219.6 49.3%	119.2 26.7%	2.8 0.6%	60.2 13.5%
PB 209	1.0	280.8	24.8 8.8%	1.2 0.4%	236.8 84.0%	71.2 25.0%	124.4 44.0%	3.6 1.3%	36.0 12.8%
PB 210	0	382.8	24.6 6.4%	1.2 0.3%	310.8 81.0%	222.0 57.9%	31.8 3.8%	1.2 0.3%	51.0 13.3%

A = total number of cells per liter.
B = total number of diatoms per liter.
C = total number of dinoflagellates per liter.
D = total number of flagellates per liter.
E = total number of *Platymonas* sp. per liter.
F = total number of *Dinobryon balticum* per liter.
G = total number of *Calycomonas vangoorii* per liter.
H = total number of unidentified flagellates per liter.

Table 23 B. Percentage composition and total number of cells of the dominant algal forms from the deep layer during Cruise III. The total number of individuals, followed by their percentage composition, is listed for each of the samples in column A-H. The total number of individuals per liter is obtained by multiplying the numbers in the columns by 1000. All depths are in meters.

Station Number	Sample Depth	A	B	C	D	E	F	G	H
PB 213	8.0	1660.2	1629.4 98.0%	1.2 0.1%	13.2 0.8%	256.6 15.4%	50.8 3.1%	40.8 2.4%	1131.2 68.0%
PB 215	8.0	1578.4	1565.6 99.1%	0.8 0.1%	2.8 0.2%	317.6 20.1%	54.0 3.4%	31.6 2.0%	1048.8 66.4%
PB 217	5.0	275.2	224.4 81.5%	0.0	24.0 8.7%	114.4 41.5%	0.8 0.3%	6.0 2.2%	46.0 16.7%

A = total number of cells per liter.
B = total number of diaotms per liter.
C = total number of dinoflagellates per liter.
D = total number of flagellates per liter.
E = total number of *Nitzschia delicatissima* per liter.
F = total number of *Chaetoceros wighami* per liter.
G = total number of *Thalassiosira nordenskiöldii* per liter.
H = total number of *Chaetoceros socialis* per liter.

Table 23 C. Percentage composition and total number of cells of the dominant algal forms from the shallow brackish water layer outside Prudhoe Bay during Cruise III. The total number of individuals, followed by their percentage composition, is listed for each sample is columns A-H. The total number of individuals per liter is obtained by multiplying the numbers in the columns by 1000. All depths are in meters.

Station Number	Sample Depth	A	B	C	D	E	F	G	H
PB 212	0	196.8	19.0	2.4	168.0	123.6	7.2	11.6	20.8
			9.6%	1.[illegible]%	85.3%	62.8%	3.6%	5.9%	10.6%
PB 212	4.0	197.5	38.9	0.[illegible]	123.5	62.8	4.4	16.8	31.5
			22.0%	0.2%	73.7%	37.5%	2.6%	10.0%	18.8%
PB 213	0	148.8	24.0	1.2	115.2	59.2	10.0	14.0	27.2
			16.1%	0.8%	77.4%	39.8%	6.7%	9.4%	18.3%
PB 215	0	214.4	32.0	2.4	74.4	21.6	7.6	6.4	26.8
			14.9%	1.1%	34.7%	10.0%	3.5%	3.0%	12.5%
PB 216	0	355.2	95.6	4.0	246.0	146.8	8.0	13.6	73.2
			26.9%	1.1%	69.2%	41.3%	2.2%	3.8%	20.6%
PB 216	5.0	274.4	62.8	1.6	192.4	159.2	2.8	3.2	22.8
			22.9%	0.6%	70.2%	58.1%	1.0%	1.2%	8.3%
PB 217	0	220.2	16.0	3.2	180.0	140.4	2.4	8.0	28.4
			7.3%	1.5%	81.8%	63.8%	1.1%	3.6%	12.9%
PB 218	0	163.8	19.1	0.3	129.6	104.8	2.0	2.8	13.2
			11.7%	0.2%	79.2%	64.0%	1.2%	1.7%	8.1%
PB 219	0	242.0	22.8	1.6	193.6	174.0	4.8	4.0	10.4
			9.4%	0.7%	80.0%	71.9%	2.0%	1.7%	8.4%
PB 219	5.0	159.8	35.2	1.6	104.0	66.4	10.4	8.0	19.2
			22.0%	1.0%	65.0%	41.6%	6.5%	5.1%	12.0%
PB 223	0	183.0	15.0	0.0	105.0	49.8	2.4	0.0	45.0
			8.2%		57.3%	27.2%	1.3%		24.6%

A = total number of cells per liter.
B = total number of diatoms per liter.
C = total number of dinoflagellates per liter.
D = total number of flagellates per liter.
E = total number of *Platymonas* sp. per liter.
F = total number of *Dinobryon balticum* per liter.
G = total number of *Calycomonas vangoorii* per liter.
H = total number of unidentified flagellates per liter.

in the bottom ice and water samples respectively, for 25 May. The species composition in the 1972 samples from Reindeer Island was different from that of 1971. *Fragilariopsis* spp. were rare and *Nitzschia frigida* was not seen at all. The 1972 samples contained a large variety of species, including *Chaetoceros septentrionalis* Oestrup, *Navicula directa*, *N. debilissima* Grunow, *N. pediculus* Cleve, *N. gelida* Grunow, *N. sibirica* Grunow, and *Gyro-Pleurosigma* spp.; none of these were very numerous. Small flagellates, which were more numerous in 1972 than in 1971, made up 17.5% of the total number of cells in the bottom ice sample and 30% of the cells in the water sample taken off Reindeer Island on 25 May 1972. Euglenoids, cryptophytes and prasinophytes were some of those represented.

The bottom ice sample collected in Prudhoe Bay on 25 May 1972, was similar to the bottom ice sample of 10 May 1971, taken off Reindeer Island, in that it had a large number of *Nitzschia frigida* and *Fragilariopsis* spp., which accounted for 23.5% of the cells. Diatoms such as *Diploneis* sp., *Navicula debilissima*, *N. gelida*, *N. transitans* Cleve and *Cylindrotheca closterium* accounted for 11.6% of the total number of cells. Unidentified pennates comprised 59.6% of the cells and flagellates comprised 3.6% of the cells. Flagellates were more abundant in the water sample and made up 34.8% of the total cells. Cryptophytes and prasinophytes were abundant, but the majority of flagellates were unidentified. Most of the diatoms in the water sample were ice forms, although two *Chaetoceros* cells and one *Thalassiosira* cell were also counted.

The species listed above were observed with an inverted microscope at 500 X magnification. Since positive identification of many pennate diatoms requires examination of the empty frustules under 1000 X magnification, some of the identifications are uncertain. A more complete description of these species is given in the discussion (section 4.2).

Three major phytoplankton communities were encountered during summer sampling. During Cruise I pennate diatoms were the dominant forms found inside Prudhoe Bay. At stations PB 6-11 they accounted for 50-68% of the total number of cells (Table 21-A, column E). The identified forms included *Amphora* spp., *Navicula transitans*, *N. pediculus*, *N. debilissima*, and *Gomphonema exiguum*, but the majority of the pennate diatoms were unidentified. A euglenoid-like cell was quite abundant in some of the Prudhoe Bay samples from Cruise I (Table 21-A, Column F). It varied in length from 20-30 μm and contained numerous disc-like chloroplasts. At station PB 6 it accounted for 31.7% of the total number of cells. Other flagellates were rare and usually accounted fro less than 10% of the total.

The second major community occurred below the salinity discontinuity and contained large numbers of pelagic centric diatoms (Tables 21-B and 23-B). During Cruise I at stations PB 12, 16, and 17 the centric diatoms accounted for 54, 93, and 33% of the total number of cells respectively. A similar pattern was observed in the data from Cruise III. At stations PB 213 and 215 diatoms accounted for 98 and 99% of the total cells respectively. The most abundant species were *Chaetoceros socialis*, *Nitzschia delicatissima* Cleve, *Thalassiosira nordenskiöldii* and *Cylindrotheca closterium*. At stations PB 213 and 215, for example, *Chaetoceros socialis* accounted for 68 and 66% of the total cells respectively. At station PB 12 *Thalassiosira nordenskiöldii* accounted for 39% of the cells. Other species encountered were *Chaetoceros atlanticus*, *Ch. wighami*, *Ch. septentrionalis*, *Ch. compressus* Cleve and Schütt, *Melosira juergensi* C. A. Agardh, *Porosira glacialis* Jørgensen and *Thalassiosira gravida*. *Eucampia zoodiacus* Ehrenberg and *Chaetoceros furcellatus* Bailey spores were common at stations PB 213 and 215, and *Chaetoceros convolutus* Castracane, *Ch. decipiens* Cleve and *Rhizosolenia hebetata* f. *semispina* (Bailey) Gran were also occasionally seen.

The brackish surface water samples, with the exception of those taken inside Prudhoe Bay during Cruise I, were always dominated by microflagellates, the third major community. This community was especially well developed during Cruise II and extended as deep as 7 or 8 m at stations PB 120 and 121 (Table 22). Flagellates comprised over 80% of the total cells at many of the stations, and averaged 68% during Cruise II. The most abundant identified species were *Monosiga marina* Grøntved, *Dinobryon balticum*, *Calycomonas vangoorii* (Conrad) Lund and *Platymonas* sp. (*Platymonas* is a tentative identification; a more complete discussion is given in section 4.2). *Monosiga marina* accounted for 43% of the cells at station PB 120, but usually ranged from 6-30%. It was rarely seen in the Cruise III samples. *Dinobryon balticum* was present at most of the stations, averaging 6.4% of the total number of cells and ranging between 0 and 17% during Cruise II. *Dinobryon balticum* was also abundant during Cruise III, especially inside Prudhoe Bay, where is averaged 19.3% of the total cells (Table 23-A, column F). *Calycomonas vangoorii* was common in most of the samples from Cruise II and averaged 5.7% of the total number of cells, with a range between 0 and 21.5%. It was also common in the lagoon surface water sampled during Cruise III, averaging 4.6% of the total number of cells. The 5 μm *Platymonas* species was present at varying concentrations during all three cruises, but was most abundant in the lagoon surface water during Cruise III, where it averaged 45.9% of the total number of cells and reached concentrations of 174 thousand cells per liter. During Cruises I and II it averaged 4.8 and 13.4% of the total number of cells respectively (Tables 21-C and 22).

Other flagellates present were *Diaphanoeca grandis* W. Ellis, *Calycomonas ovalis* Wulff and *Ebria tripartita* (Schumann) Lemmermann. Unidentified flagellates were common in all of the brackish water samples and sometimes accounted for more than 40% of the cells.

Dinoflagellates were present in nearly all of the samples, but rarely accounted for more than 4% of the total number of cells. The species most commonly encountered were *Peridinium pallidum*

Ostenfeld, *P. minusculum* Pavillard, *P. brevipes* Paulsen and *Goniaulax catenata*. *Dinophysis arctica* Mereschkowsky, *Peridinium trochoideum* (Stein) Lemmermann, and *Gymnodinium lohmanni* Paulsen were also occasionally seen.

The highest number of cells during Cruises I and III occurred in the deep layer below the salinity discontinuity. Concentrations of 1 and 1.6 million cells per liter were found at stations PB 12 and 16. The concentration in the deep layer during Cruise III was 1.7 and 1.6 million cells per liter at stations PB 213 and 215 respectively. The concentration in the brackish water layer during all three cruises was 26-445 thousand cells per liter.

3.7 Nitrate and Ammonia Uptake Rates

Nitrate and ammonia uptake rates are listed in Tables 24 and 25. The ammonia concentration in the water samples was not measured at most of the stations during Cruises I and II, and therefore the percent enrichment of nitrogen-15 ammonia was estimated by assuming the ammonia concentration in the water to be 2 μg NH_3-N liter^{-1}.

Nitrate and ammonia uptake rates were higher during Cruise I than during Cruise II, and this reflects the higher primary productivity rates measured during Cruise I. At all stations except PB 12, ammonia uptake rates exceeded nitrate uptake rates. PB 12 was the only station where nitrate and ammonia uptake rates were measured on a deep water sample.

Table 24. Nitrate and ammonia uptake rates in μg liter^{-1} hr^{-1} measured during Cruise I. All depths are in meters.

Station Number	Sample Depth	NO_3 Light	NO_3 Dark	NH_3 Light	NH_3 Dark
PB 1	0	0.093	0.045	0.369	0.151
PB 1	2.0	0.120	0.040	0.235	0.189
PB 5	1.5	0.077	0.050	0.171	0.186
PB 6	1.5	0.349	0.108	0.896	0.556
PB 8	1.5	0.259	0.127	1.076	0.729
PB 10	0	0.210	0.068	0.204	0.105
PB 12	2.0	1.432	1.172	0.747	0.212
PB 15	2.5	0.040	0.038	0.084	0.051
PB 19	2.5	0.030	0.021	0.073	0.063
PB 22	1.5	0.036	0.021	0.060	0.033

Table 25. Nitrate and ammonia uptake rates in μg liter^{-1} hr^{-1} measured during Cruise II. All depths are in meters.

Station Number	Sample Depth	NO_3 Light	NO_3 Dark	NH_3 Light	NH_3 Dark
PB 101	2.5	0.010	0.013	0.036	0.045
PB 104	3.0	0.007	0.043	0.036	0.030
PB 107	5.0	0.009	0.002	0.027	0.018
PB 108	3.5	0.017	0.003	0.046	0.040
PB 112	1.0	0.086	0.021	0.196	0.128
PB 117	2.0	0.012	trace	0.054	0.034
PB 119	5.0	0.028	0.014	0.067	0.042
PB 122	4.0	0.022	none	0.062	0.073
PB 123	4.5	0.008	0.004	0.036	0.025

DISCUSSION

4.1 General

The recent measurements of chlorophyll concentration in arctic sea ice (Apollonio 1965, Meguro et al. 1967, Clasby et al. 1973) indicate that the contribution of the ice algae to the annual primary productivity may be considerable and this is also true of the Beaufort Sea near Prudhoe Bay. The maximum recorded chlorophyll *a* concentration in the bottom ice off Reindeer Island was 97.9 mg m^{-3} on 10 May 1971, but this value is not exceedingly great when compared with those of other workers. Meguro et al. (1967) found an average chlorophyll *a* concentration of 120.3 mg m^{-3} in the bottom ice off Wainwright, Alaska, and Apollonio (1965) found values as high as 1,460 mg m^{-3} in Jones Sound near Devon Island. Because the greatest concentration of algae is restricted to the bottom 5-20 cm of ice, these high values can be misleading and when expressed as mg m^{-2}, the above mentioned values of Meguro and Apollonio both approximate 20. Clasby et al. (1973) measured a maximum chlorophyll *a* concentration of 30 mg m^{-2} in the bottom ice near Barrow and the maximum value off Reindeer Island was about 9.8 mg m^{-2}.

The chlorophyll concentration in the bottom ice is often variable (Apollonio 1965, Horner 1972) and this reflects both the patchy distribution of the ice algae, and the difficulty in getting a quantitative measurement from ice core samples. Because the bottom ice layer is quite fragile, some of the sample can be lost when the core is cut and the recorded chlorophyll concentrations should therefore be considered minimum values.

The spring ice algal bloom began later in Prudhoe Bay than off Reindeer Island (section 3.3, Table 8) and the reason for this may be differences in light penetration through the ice. The most recent data from Barrow indicate that the major factor controlling the time of the spring bloom is light intensity in the bottom ice. Clasby et al. (1973) have shown that the ice algae will not actively photosynthesize until the light intensity exceeds 66 lux and these data agree well with the measurements of Bunt (1963). Since light penetration is a function of snow cover and ice structure, these are the most likely factors causing the delay in the ice algal bloom in Prudhoe Bay.

The 1972 data (Tables 4 and 8) show a decrease in the chlorophyll *a* concentration in the bottom ice between 18 and 25 May, concurrent with a decrease in the salinity of the water beneath the ice, thus marking the end of the ice algal bloom off Reindeer Island. This agrees with the data of Horner (1972) which showed bottom ice salinities above 6.5°/₀₀ until the end of May and beginning of June, after which concurrent drops in bottom ice salinity, water salinity, and bottom ice chlorophyll concentration indicate the end of the ice algal bloom. Although bottom ice salinity was low, this reflects the method of measurement (melting the bottom ice sample before measuring the salinity), and does not necessarily indicate that the algae in the brine pockets between the ice crystals are living in brackish conditions. The work of Bunt (1963), Meguro (1967) and Horner (personal communication) show that the salinity of the brine pockets is equal to if not greater than that of the underlying sea water until the beginning of ice melt, after which the frazzled bottom ice layer is quickly washed away by water currents and brine drainage, thus ending the ice algal bloom.

The nitrate concentration inside Prudhoe Bay fell by 3.1 μg-atoms NO_3-N liter^{-1} between 18 and 27 May 1972, and concurrently the chlorophyll *a* concentration in the bottom ice and water increased by 17.5 and 1.7 mg m^{-3} respectively. If the increments in chlorophyll concentration are expressed as mg m^{-2}, then the concentration in the bottom ice layer, assuming a minimum sample thickness of 10 cm, increased by 1.76 mg m^{-2} and that of the water increases by 0.85 mg m^{-2} (the distance from the bottom of the ice to the bottom of the bay was about 0.5 m). The total nitrate nitrogen decrease in the water column during this period was about 21.7 mg m^{-2}, and this may not have been caused by the algae in the water alone. Parsons et al. (1961) measured the chemical composition of several diatom species and found that the nitrogen to chlorophyll *a* ratios varied from 4-12. Using these figures, the algae in the water column alone could have consumed only 3-10 mg NO_3-N m^{-2}, and the water and ice communities together could have used from 8-30 mg NO_3-N m^{-2} between 18 and 25

May. Such mass balance estimates, although based on net rather than gross chlorophyll production and not allowing for nutrient cycling, nevertheless suggest that the ice algae may be getting some of their nutrient from the water column, and that diffusion of nutrient salts into as well as out of the brine pockets may be occurring until the thaw begins, after which melt and brine drainage restrict the flow to one direction, from the ice to the water.

The data from Barrow also suggest the possibility that nutrients from the water may be diffusing into the brine pockets of the bottom ice. The amount of inogranic nitrogen necessary to produce 30 mg m^{-2} of chlorophyll *a*, the maximum value measured in the bottom ice by Clasby et al. (1973), would be 120-360 mg inorganic nitrogen m^{-2} if a nitrogen to chlorophyll *a* ratio of 4-12 is assumed, and if the ice column were 2 m thich, a maximum value for May, the inorganic nitrogen concentration would have to decrease by 4-12 μg-atoms $liter^{-1}$ to provide the necessary nitrogen. Horner (personal communication) found that the ammonia and nitrate concentrations in the ice column at Barrow averaged 4.8, 3.3, and 4.4 μg-atoms NH_3-N $liter^{-1}$ and 1.6, 1.7, and 2.8 μg-atoms NO_3-N $liter^{-1}$ during March, April and May respectively, Thus, although a bottom ice chlorophyll concentration of 30 mg m^{-2} developed during April and May, no significant decrease in the average inorganic nitrogen in the ice column occurred. This should not suggest, however, that nutrients were limiting production in the bottom ice. The nitrate concentration in the water beneath the ice exceeded 9 μg-atoms NO_3-N liter^{-1} during the bloom and this would be more than enough to supply the need if exchange between the bottom ice and the water column were occurring. The above discussion is speculative, and measurements of particulate nitrogen concentration would provide more concrete evidence on which to assess the possible contribution of nutrients in the water to the ice algal productivity.

The nitrate nitrgoen concentration during the three cruises never exceeded 0.8 μg-atoms liter^{-1} except at stations PB 9-11 (Table 18, section 3.5). Ammonia concentration was also quite low, averaging 0.8 μg-atoms NH_3-N liter^{-1} during Cruise III and 1.7 μg-atoms liter^{-1} at stations PB 1-8 during Cruise I.

Eppley et al. (1969) measured the half saturation constants for nitrate and ammonia uptake of several species of marine phytoplankton. The half saturation constants varied from 1.4-144 μg-atoms NO_3-N liter^{-1} and 1.4-130 μg-atoms NH_3-N liter^{-1}. Eppley and Thomas (1969) compared the half saturation constants for nitrate limited growth and nitrate limited uptake and concluded that the constants were very similar; therefore the half saturation constants for nitrate uptake could be considered indicative of the concentration at which nitrate nitrogen would be limiting. These data suggest that the nitrate and ammonia concentrations measured during the Prudhoe Bay cruises may have been limiting.

MacIssac and Dugdale (1969) measured the half saturation constants for nitrate uptake by natural populations of phytoplankton. They reported values as low as 0.01 μg-atoms NO_3-N liter^{-1}, but suggested that these low values may reflect experimental error due to the difficulty of applying the ^{15}N technique to extremely oligotrophic waters.

Schell (Kinney et al. 1972) suggested that the low inorganic nitrogen to phosphate ratios measured in Simpson Lagoon and Harrison Bay are indicative of nitrogen difficiency. During Cruises I-III the inorganic nitrogen to phosphate ratios were usually below three.

Thus, the rapid consumption of inorganic nitrogen in the spring, the low ratio of the inorganic nitrogen to phosphate concentration, and the very low nitrate and ammonia concentrations during the cruises are all indicative of nitrogen-limited growth in Prudhoe Bay and the surrounding waters during the summer.

The silicate concentration was probably not limiting during the Prudhoe Bay study. Goering et al. (1973) measured silicon uptake rates of natural populations and found the half saturation constants for uptake to be about 3 μg-atoms H_4SiO_4-Si liter^{-1}. Paasche (1973 b) measured silicate uptake rates for several marine diatom species and found the half saturation constants varied from 0.80-3.37 μg-atoms H_4SiO_4-Si liter^{-1}. Paasche (1973 a) also studied the uptake rates and silicon limited growth rate of *Thalassiosira pseudonana* Hasle and Heimdal and found that, although the half saturation constant for uptake was 1.4-2.6 μg-atom liter^{-1}, that for silicon limited growth was 0.5-0.8 μg-atoms liter^{-1}. The cells maintained high growth rates at lower silicon concentrations by forming thinner frustules. This evidence supports the contention that the silicon concentrations during the three cruises, which were above 5 μg-atoms H_4SiO_4-Si liter^{-1}, were not limiting.

Silicate concentration during 1971 and 1972 was consistantly higher inside Prudhoe Bay and in the shallow brackish water, than in the deeper high salinity layer. Part of the reason for this is that the deep layer supported a higher diatom population (section 3.6). In addition, silicate concentration in the North Slope river water is quite high (Kinney et al. 1972). This could also contribute to the high silicate concentration in the brackish water. The stations with the lowest salinities, PB 9-11 (Fig. 1 and Table 5), had silicate concentrations of 27.0, 28.3 and 25.8 μg-atoms H_4SiO_4-Si liter^{-1}, while at other brackish water stations during Cruise I, the silicate concentration was around 16 μg-atoms liter^{-1} (Table 18).

The phosphate concentration also appears to be influenced by fresh water run-off. During 1971 and 1972 the Prudhoe Bay phosphate concentration was about the same as that measured in the deep water until spring breakup, afterwhich the brackish water phosphate concentration was consistantly lower. According to Schell (Kinney et al. 1972) the phosphate concentration in the North Slope fresh water environment is extremely low.

The chlorophyll concentrations for Cruises I-III shown in Figure 5 are arithmetic means of the data listed in Tables 9-11. Figure 5 shows that the means of the chlorophyll concentration in the deep water during Cruises I and III are higher than the means of the measurements taken inside Prudhoe Bay. A one way analysis of variance was run to test the null hypothesis that the means of the chlorophyll concentrations were the same in the deep high salinity layer and the shallow water inside Prudhoe Bay. The null hypothesis was rejected at the 5% level for the Cruise III data only. The chlorophyll concentration in the deep and shallow water during Cruises I and II were not different at the 5% confidence level. Although Figure 5 shows that the means of the chlorophyll concentrations in the deep high salinity layer and the brackish Prudhoe Bay water during Cruise I differed by 1.8 mg m^{-3}, the high variance associated with the means reduced the significance of the difference. A one way analysis of variance also indicated that the means of the chlorophyll concentrations measured inside Prudhoe Bay during Cruises I-III were not significantly different. All statistical tests were conducted at the 5% level unless otherwise stated.

A one way analysis of variance was also run on the replicate chlorophyll samples taken during Cruise III (Table 11) and the within group mean square error was used to generate a 95% confidence interval for the chlorophyll determinations. The interval was ±0.4 mg m^{-3} for the UNESCO data and ±0.5 mg m^{-3} for the data obtained by the Lorenzen technique.

If phaeophytin were interfering with the chlorophyll determinations, then the chlorophyll *a* concentration calculated from the UNESCO-SCOR (1966) equations should consistantly exceed the values obtained by the phaeophytin technique. To test this possibility, the arithmetic mean of the difference between the UNESCO and phaeophytin results from each station was calculated and a t test showed that this mean was not significantly greater than zero (Appendix III, Table 4). The data therefore indicate that phaeophytin was not interfering with the UNESCO chlorophyll results.

These results differ from those obtained by Alexander and Billington (Kinney et al. 1972), who found high phaeopigment concentrations in Harrison Bay and Simpson Lagoon. According to Lorenzen (1967), if the initial absorbency at 663 nm is below 0.2, the precision of the phaeophytin technique is so low that the results become questionable. This was the case with nearly all of the Cruise III samples, and may be an explanation for this discrepancy. In addition, the extraction technique used by Alexander and Billington differed from that used on the Prudhoe Bay samples. The effect of these factors on chlorophyll determinations needs study.

Although Table 15 shows that the means of the primary productivity results from the deep water samples taken during Cruises I and III were higher than the means of the results from the shallow brackish water stations, a one way analysis of variance indicated that the means were significantly different only during Cruise III. If more samples were available from the deep layer during Cruise I, the variance of the deep water mean may have been reduced enough to indicate a significant difference between the average deep and shallow water productivity.

One of the most productive periods in the arctic marine environment occurs in August and September. Horner (1972 and personal communication) found high primary productivity rates near Barrow during August and the highest annual phytoplankton standing stocks in the central Arctic Ocean and the Canadian archipelago occur in August and September (Usachev 1961, Bursa 1961). The high productivity and standing stock in the deep water during Cruises I and III may be part of the late summer bloom, which is characteristic ot arctic waters.

Usachev (1961) found that during August the diatom community was dominated by *Chaetoceros socialis* and other diatoms associated with this community and considered summer forms include *Chaetoceros atlanticus*, *Ch. compressus*, *Ch. convolutus* and *Eucampia zoodiacus*. The dominant species in the deep layer near Prudhoe Bay during Cruise III was *Chaetoceros socialis* and the other species listed were also present. *Chaetoceros socialis* is abundant near Barrow and Igloolik in August (Horner 1969, Bursa 1961) and appear to be generally generally characteristic of arctic summer conditions.

Thalassiosira nordenskiöldii and *T. gravida*, which were most abundant during Cruise I, are spring forms. At point Barrow and Igloolik they were most abundant during June and July (Horner 1969, Bursa 1961). Other spring forms which were abundant in the deep water near Prudhoe Bay during Cruises I and III include *Nitzschia delicatissima* and *Chaetoceros furcellatus*. *Nitzschia delicatissima* was not reported by either Horner (1969) or Bursa (1961), possibly because it is difficult to recognize, but it was one of the most abundant species off Reindeer Island during Cruise III. Usachev (1961) considered it to be a spring form which is arctic-boreal and neritic. Near Barrow *Chaetoceros furcellatus* spores were most abundant in the spring near the edge of the ice (Horner 1969). Horner felt that it was present later but was not recognized because it lacked resting spores. Bursa (1961) found it most common during the *Chaetoceros socialis* bloom in August. *Chaetoceros furcellatus* spores were common in the deep water off Reindeer Island during Cruise III.

Thus, the deep water diatom community near Prudhoe Bay was dominated by arctic and arctic-boreal forms which are neritic and common in the spring and early summer. *Distephanus speculum* Müller, which is common in the central Arctic Ocean (Usachev 1961, Tibbs 1967, Kawamura 1967) and in temperate neritic waters (Horner 1969), was seen only once near Prudhoe Bay. *Skeletonema costatum* (Greville) Cleve, which is abundant in temperate neritic waters, was not seen in any of the Prudhoe Bay samples.

The pennate diatom community found inside Prudhoe Bay during Cruise I had very high productivity (Table 12). Since this community was limited to the shallow water inside the bay, and because the count samples contained alot of sediment, most of the diatoms were probably benthic forms which were suspended in the water column by turbulence, however, some of them may have been ice algae, which were sloughed from the ice during melt off. The pennate community was not found during Cruises II and III and therefore probably occurs only in late spring and early summer.

The flagellate community of the surface water layer was present during all three cruises, but was never very productive (section 3.4). A large percentage of this community was non-photosynthetic, composed of *Monosiga marina*, *Calycomonas vangoorii* and *Ebria tripartita*. Although *Platymonas* sp. and *Dinobryon balticum* were abundant during Cruises II and III, they were not as productive as the diatoms. Centric diatoms were occasionally seen in the brackish layer, but were never abundant and usually appeared to be in poor condition. This is in agreement with Horner (1969) and Bursa (1961) who found decreases in the surface diatom populations when the salinity dropped during melt-off.

Alexander (1974) found large numbers of fresh water flagellates in Simpson Lagoon and Harrison Bay, in particular *Chromulina* sp. and *Rhodomonas minuta* Skuja, and suggested that their occurrence was related to salinity stratification. If present in the Prudhoe Bay samples, these species were rendered unrecognizable by the formalin preservative. Although the salinity-temperature discontinuity appears to have restricted the diatoms to the deep layer near Prudhoe Bay, this was not observed in the samples from Harrison Bay and

Simpson Lagoon, however, dinoflagellates and silicoflagellates did increase with depth. The highest recorded primary productivity rates occurred in early August and increased with depth in the Beaufort Sea off Simpson Lagoon. This is similar to the pattern observed near Prudhoe Bay.

Because it was not possible to obtain a consistent series of measurements during the productive season at Prudhoe Bay, the primary productivity data are difficult to interpret. The average mid summer productivity in the deep layer during the three cruises was 1-3 mg C m^{-3} hr^{-1}, if the results from station PB 12, which seem to be abnormally high, are excluded. Assuming the depth of the deep layer in the lagoons to average 3 m and a day length of 20 hours, the primary productivity in the deep layer for July and August (62 days) probably exceeds 10 g C m^{-2}. Because the most productive periods in the nearshore arctic environment occur in June and late August (Horner 1972 and personal communication), the contribution of the deep layer to the total annual primary productivity may exceed 10 g C m^{-2} by two or more times. The average primary productivity in the shallow lagoon water during the three cruises was 0.45 mg C m^{-3} hr^{-1}. The depth of the shallow layer averaged 5 m and, assuming a day length of 20 hours, the primary productivity of the shallow layer during July and August is probably about 3 g C m^{-2}. The annual primary productivity of the water column in the lagoons therefore may range between 13 and 23 g C m^{-2}. Although the bottom ice chlorophyll concentration suggests that the contribution of the ice algae to the annual productivity is significant, the data are scant and the most recent information from Barrow (Horner personal communication) indicates that the assimilation efficiencies are quite variable, therefore estimation of the annual primary productivity of the ice algae from the chlorophyll concentration is not advisable. From the Barrow data, Alexander (1974) has estimated the annual primary productivity of the ice algae to be about 5 g C m^{-2}, probably the most reliable figure which could presently be applied to the lagoon and Beaufort Sea ice algae communities. Matheke (1973) measured the primary productivity of the benthic microalgae near Point Barrow and recorded an average value for July and August of 26.7 mg C m^{-2} hr^{-1}. Assuming the productive season extends from the beginning of July through September, and a day length of 20 hours, the benthic microalgae may produce about 50 g C m^{-2} yr^{-1}. Since no data are available on the productivity of the benthic microalgae in the lagoons near Prudhoe Bay, this figure is probably the best available. Therefore the total annual productivity of the offshore lagoons near Prudhoe Bay may be about 80 g C m^{-2}, of which 6% is produced by the ice algae, 62% by the benthic microalgae, and 31% by the phytoplankton.

Although a spring ice algal bloom does occur in Prudhoe Bay, the rapid drop in nitrate concentration during the bloom suggests that, contrary to offshore conditions, nutrients may limit the ice algal productivity. In addition, the low chlorophyll concentration and the late occurrence of the bloom indicate that the total annual primary productivity of the ice algal community inside Prudhoe Bay is much lower than outside the bay, and may be as low as 1 g C m^{-2} yr^{-1}. The high spring salinity and rapid change from hypersaline to highly dilute conditions during melt-off probably suppresses the spring plankton bloom in the bay. Nevertheless, a relatively productive pennate diatom community does develop in July, with an average productivity of 5 mg C m^{-3} hr^{-1}. Assuming the average depth of the bay to be 1.5-2 m and a day length of 20 hours, the primary productivity for July may be about 5-6 g C m^{-2}. The average productivity for August was 1 mg C m^{-3} hr^{-1}. Applying the same day length and water depth assumptions as above, the total primary productivity inside Prudhoe Bay for August and September may be about 2-2.5 g C m^{-2}. Although a benthic microalgae community may develop during July, it is probably washed out by high waves during August and September and therefore does not contribute to the total annual primary productivity during those months. The total annual primary productivity inside Prudhoe Bay therefore probably does not exceed 10 g C m^{-2}, 10% of which may come from the ice algal bloom.

Alexander (1974) estimated the annual productivity of the water column in Harrison Bay and Simpson Lagoon to exceed 10-15 g C m^{-2} and compared this with other northern temperate values (55.91 g C m^{-2} yr^{-1} in the mid Pacific, 90-240 g C m^{-2} yr^{-1} in the Gulf of Alaska and the Washington, Oregon coast). McRoy et al. (1972) measured maximum primary productivity rates of 4.1 g C m^{-2} day^{-1} in the Bering Strait during June and the data from Frobisher Bay (Grainger 1971) suggest an annual productivity in excess of 40 g C m^{-2}. The data from Barrow (Horner 1972 and personal communication) suggest that the nearshore primary productivity of the water column may be about 10 g C m^{-2} yr^{-1}, and Ryther (1963) indicated that the total annual primary productivity of the central Arctic Ocean is probably less than 1 g C m^{-2}. The annual primary productivity of Prudhoe Bay and the nearshore lagoons therefore exceeds the value expected in the central Arctic Ocean, but is less than that of more temperate regions, perhaps due to low nutrient levels and shortness of the growing season.

4.2 Important and Interesting Species

The main taxonomic texts used for species identification are Gran (1908), Hendey (1964), Hustedt (1930) and Schiller (1933-1937). Other works were used occasionally and will be refered to in the discussion. The discussion will cover the dominant forms and those whose identification is uncertain.

4.2.1 Pennate Diatoms

Positive identification of many pennate diatoms requires examination of the empty frustules under 1000 X magnification. Because this was not possible with the standing stock samples, many of the identifications are uncertain, and based on size, shape and general pattern of striation as visible in the preserved cells at 500 X magnification.

Amphora spp.: Cells of this genus were sometimes found in the standing stock samples, most often in those from Prudhoe Bay during Cruise I. This genus is easily recognized and a description of its characteristics is available in Hendey (1964).

Cylindrotheca closterium Reimann and Lewin: This species was formerly classified as *Nitzschia closterium* (Ehrenberg) W. Smith but after careful examination of the frustules under high magnification, it was transfered to the genus *Cylindrotheca* Rabenhorst (Reimann and Lewin 1964). This species was common during all three cruises and was occasionally seen in the spring samples.

Diploneis sp.: Several members of this genus were found in the samples from Reindeer Island and Prudhoe Bay taken on 25 May 1972. The length of the apical axis ranged from 21-45 μm and in one individual it was 60 μm long. Gran (1904) reported seeing *Diploneis litoralis* (Donkin) Cleve with an apical axis of 22-63 μm, and Cleve (1896) also reported this species. *Diploneis litoralis* is similar to *D. Smithii* (de Brebisson) W. Smith, also reported by Gran (1904). Both species are wide spread in salt and brackish water and positive identification requires examination of the empty frustules.

Gomphonema exiguum Kützing: Several members of this species were observed in the water and ice samples taken off Reindeer Island on 10 May 1971. The apical axis varied in length from 21-44 μm.

Gyro-Pleurosigma spp.: The major difference between the genera *Gyrosigma* Hassall and *Pleurosigma* W. Smith is that in the latter genus, the puncta form transverse and oblique rows, while in the former, the rows are transverse and longitudinal. These differences were not distinguishable in the standing stock samples so forms with the common characteristics of these two genera were listed as *Gyro-Pleurosigma* spp. *Gyro-pleurosigma* spp. were occasionally seen in samples from all three cruises, but were most common in the spring samples.

Navicula: The genus *Navicula* Bory has striae composed of distinct or indistinct puncta and this is the major characteristic distinguishing it from the genus *Pinnularia* Ehrenberg, whose striae are costa-like. Since these differences were indistinguishable in the count material, assignment to the genus *Navicula* was made on the basis of size and shape affinities to the species known to be arctic forms. The major difference between *Navicula* and *Achnanthes* Bory is that in the latter, only one valve has a raphe and the other has a pseudoraphe. In the standing stock samples the presence of a pseudoraphe was hard to verify, because of the difficulty in turning cells over in the counting chamber. For these reasons, many of the *Navicula*-like cells were not assigned to a genus, but were drawn and their dimensions listed.

Navicula pediculus Cleve: Cells of this type were observed in the water sample taken off Reindeer Island on 25 May 1972, and occasionally during the cruises. It had parallel striae which were slightly radiated at the ends of the valve, its apical axis was about 14 μm long and its transapical axis was 5 μm long. Cleve (1896) reported this species as having a 12 μm apical axis, a 5 μm transapical axis, and very distinct striae.

Cells similar to this were found in the ice and water samples collected from both Reindeer Island and Prudhoe Bay on 25 May 1972, but differed from *N. pediculus* in having very weak striation. These cells are similar to the discription given by Cleve (1896) of *Navicula debilissima* Grunow. The apical axis of the Prudhoe Bay cells varied from 12-44 μm.

Navicula sibirica Grunow: This species was observed in girdle view in the water and ice samples taken from the Reindeer Island site on 25 May 1972. The apical axis was about 36 μm long and the cells usually occurred in pairs as pictured in Gran (1904). A valve view of *N. sibirica* was not seen.

Navicula transitans Cleve: This species was common in the ice and water samples taken on 25 May 1972, and was occasionally seen in the samples taken during the summer cruises. The apical axis ranged from 60-89 μm and the transapical axis from 16-18 μm. Heimdal (1970) reported that the apical axis varied from 54-79 μm and the transapical axis from 9-11 μm. According to Gran (1904) the apical axis was 56-96 μm and the transapical axis 15-21 μm.

A species similar to *N. transitans*, *N. directa*, was also occasionally observed. The only difference between the two species is the length-width ratio which, according to Heimdal (1970), is about 10 in *N. directa* and somewhat less in *N. transitans*. Several specimens shorter than 60 μm were observed and Gran (1904) grouped these together as the species *Navicula gelida* Grunow.

Nitzschia delicatissima Cleve: This species was abundant in the deep layer. The average length of the apical and transapical axes was 62 and 2 μm respectively. The cells were united at the tips to form long hair like colonies. No keel puncta were visible. These cells were close to the discription given by Cupp (1943) and Hendey (1964) of *N. delicatissima*, which is a common brackish water speices.

Nitzschia frigida Grunow: This species is a common arctic form found both in the ice and in the water. The apical axis was 35-75 μm long and the cells were most abundant in the bottom ice samples taken from the Reindeer Island site on 10 May 1971, and Prudhoe Bay on 25 May 1972. They were occasionally seen in the deep layer during Cruises I and III.

Nitzschia sigmoidea (Ehrenberg) W. Smith: This species was seen once in the water sample taken off Reindeer Island on 25 May 1972, and once during Cruise I. The apical axis was 179-237 μm long and the pervalvar axis was 26 μm long. The identification was made from a diagram given in Meunier (1910).

Nitzschiella acicularis W. Smith: A diatom similar to this appeared sporadically in the samples from all three cruises. The apical axis was 45-60 μm long, the transapical axis was 3 μm long, and the cells formed radiating colonies by attaching at their apices. The identification was made from the diagram in Meunier (1910).

4.2.2 Centric Diatoms

Chaetoceros atlanticus Cleve: Usachev (1961) reported *Ch. atlanticus* to be a summer form, but Kawamura (1967) found it to be most common in the central Arctic Ocean in the late fall and winter. It was reported from Igloolik and Frobisher Bay in August, but was not abundant (Bursa 1961, 1971). A few cells were seen in the deep water samples near Reindeer Island during Cruises I and III. It is arctic-boreal and oceanic.

Chaetoceros compressus Cleve and Schütt: The single cells of this species are difficult to identify but when in colonies, some of the setae are thickened and wavy and this characteristic is diagnostic. *Ch. compressus* is arctic-boreal and neritic and was occasionally seen in the deep water samples near Prudhoe Bay.

Chaetoceros furcellatus Bailey: This species is most easily identified by its spores. Usachev (1961) considered it an arctic neritic form which occurs in late spring along with *Chaetoceros socialis*. Horner (1969) found *Ch. furcellatus* spores in early spring near Barrow and *Ch. furcellatus* was dominant near Igloolik and in Frobisher Bay during August (Bursa 1961, 1971). Usachev (1946) found large numbers of spores north of Spitzbergen in October. *Ch. furcellatus* spores were common in the deep water off Reindeer Island during Cruise III.

Chaetoceros socialis Lauder: This species is arctic-boreal and neritic, being common not only in the arctic, but also on the west coast of North America, in the North Atlantic, Norwegian Seas, North Sea, Baltic Sea and English Channel (Cupp 1943, Hendey 1964, Hustedt 1930). *Chaetoceros socialis* is also tolerant of brackish water conditions (Braarud and Føyn 1958, Bursa 1961).

Chaetoceros wighami Brightwell: This species is quite variable and difficult to identify. It is considered arctic-boreal and neritic in distribution and has been reported in brackish water (Braarud and Føyn 1958, Bursa 1961). It was common near Prudhoe Bay in the deep water samples during Cruise III.

Eucampia zoodiacus Ehrenberg: This species is arctic-boreal and neritic and is most common during the summer (Usachev 1961). It is an important part of the plankton in the northern Barents Sea during August and September and has also been reported from the Kara and Laptev seas (Usachev 1946). It has been reported near Barrow (Horner 1969) and was seen in the standing stock samples from the deep water layer near Prudhoe Bay. Cupp (1943) considered it a south temperate species.

Porosira glacialis Jørgensen: This is an arctic neritic species which is most common in the spring (Usachev 1961). It has been reported from the Barents, Kara, Laptev, and White seas (Usachev 1946) and was most common in the spring near Barrow (Horner 1969). It was occasionally seen in the deep water near Prudhoe Bay but was never abundant.

Rhizosolenia hebetata f. *semispina* (Bailey) Gran: This species has been reported from the Barents, Kara and Chukchi seas and has also been seen in the Antarctic (Usachev 1946). *Rhizosolenia hebetata* f. *semispina* was present in the deep water samples from Cruise III. Cupp (1943) considered it to be a warm water summer form.

Thalassiosira gravida Cleve: This species is a spring form which is arctic-boreal and neritic (Usachev 1961), but is also common in the central Arctic Ocean during July (Kawamura 1967). It was reported in the spring bloom at Barrow (Horner 1969) and was most often seen in the deep layer near Reindeer Island during Cruises I and III.

Thalassiosira nordenskiöldii Cleve: This was one of the dominant species in the deep layer during Cruise I. It is arctic-boreal and neritic and its distribution is similar to that of *T. gravida*. *T. nordenskiöldii* has been reported in all of the arctic coastal seas of the USSR (Usachev 1946).

4.2.3 Dinoflagellates

Goniaulax catenata (Levander) Kofoid: A dinoflagellate which was very similar to *G. catenata* was common during the cruises, but because positive identification requires examination of the plate configuration of the epicone and this was not possible, the identification is not conclusive. The sulcus and girdle configuration of the Prudhoe Bay specimens was similar to that pictured in Schiller (1933-1937) and the apical and antapical spines were also seen. Both solitary and colonial individuals were present.

Gymnodinium lohmanni Paulsen: This species was sometimes seen in the brackish water samples. It was 60-90 μm long and had a large prominent nucleus. The identification was made from the diagram in Paulsen (1908).

Peridinium pallidum Ostenfeld: This species was common in the Prudhoe Bay samples. It was very difficult to distinguish the difference between *P. pallidum* and *P. pellucidum* and so they were listed together as *P. pallidum*.

The remaining dinoflagellates listed in the summary sheets and in section 3.6 were identified from the diagrams in Paulsen (1908) and Schiller (1933-1937).

4.2.4 Flagellates

Most of the flagellates were unidentified because the formalin destroyed their diagnostic characteristics. Some flagellates are destroyed completely, causing an underestimation of the cell population. Those which were identified usually had loricae, cell walls, or other hard parts which were unaltered by the formalin.

Calycomonas vangoorii (Conrad) Lund: A cell similar to *Calycomonas vangoorii* was common in the shallow brackish water samples. Diagrams of the lorica of this species are available in Throndsen (1969) and the species was also recorded by Norris (1964), who reported it to be colorless.

Dinobryon balticum (Schütt) Lemmermann: *D. balticum* is common near Barrow (Horner 1969) and is found in the Barents, White, and Kara seas (Usachev 1946). It has also been reported near Spitzbergen, on the Norwegian coast and in the North Sea (Lemmermann 1908). *D. balticum* was most common in the shallow brackish water in Prudhoe Bay and therefore appears to be euryhaline in distribution.

Ebria tripartita (Schumann) Lemmermann: This species was common in the brackish water samples from Prudhoe Bay. It has been reported from the White Sea and southern regions of the Kara and Laptev seas (Usachev 1946) and is also common in more temperate regions (Gemeinhardt 1930). According to Deflandre (1952), *E. tripartita* reproduces by asexual division only, but one cell from Prudhoe Bay contained what appeared to be numerous spherical reproductive cells.

Monosiga marina Grøntved: This species was quite common in the brackish water layer during Cruise II. It was about 12 μm long with a single collar and one flagellum. A complete description and diagram is available in Grøntved (1952). This species is very similar to *Salpingoeca natans* Grøntved except that *S. natans* has a lorica and *M. marina* does not. Both are quite variable and have been reported in similar locations. It is possible that they are different forms of the same species and unialgal cultures could be used to test the possibility. Diagrams and a description of *S. natans* are available in Grøntved (1956).

Platymonas sp.: This 4-8 μm flagellate probably belongs to the genus *Platymonas*. It has four flagella arising from an apical depression and a pyrenoid which is covered with a cup-shaped sheath. The only difference between *Platymonas* and *Pyramimonas* is that the former has a cell wall (Lewin 1958) and the latter does not (Butcher 1959). Although this characteristic was very hard to distinguish in the samples, a few of the preserved cells had shrunk slightly, revealing what appeared to be a cell wall. This species has therefore been placed in the genus *Platymonas*.

Polyasterias problematica (Cleve) Meunier: This species was occasionally seen in the net samples from Prudhoe Bay. It has also been reported by Meunier (1910), Horner (1969) and others. Its taxonomic affinities are uncertain.

Radiosperma corbiferum Meunier: This species was occasionally seen in the net samples from Prudhoe Bay and was common in the net samples taken in the Beaufort Sea near the Alaskan coast during 1973 (Horner, personal communication). It is considered rare and its taxonomic affinities are unknown (Horner 1969).

SUMMARY

1. High chlorophyll *a* concentration in the bottom ice layer off Reindeer Island indicated that the ice algae may be responcible for a large percentage of the annual primary productivity. The maximum recorded chlorophyll *a* concentration was 9.8 mg m^{-2} on 10 May 1971. There were 83 million cells per liter in the bottom ice, most of which were *Fragilariopsis* spp.
2. Nitrate nitrogen concentration was high in the winter and early spring (3.7-10.2 μg-atoms $liter^{-1}$), but was quickly utilized during the spring bloom and was usually below 1 μg-atom $liter^{-1}$ during July and August. Nitrate concentration probably limited growth during the summer.
3. After ice breakup, the water column became stratified due to fresh water run-off and ice melt. Surface salinities were usually 15-20°/₀₀, while between 3 and 6 m depth the salinity increased to above 28°/₀₀, and below 6 m to 29-33°/₀₀. The surface and deep layers were also characterized by differences in average chlorophyll *a* concentration, primary productivity and algal species composition.
4. Three phytoplankton communities occurred near Prudhoe Bay during July and August. 1) A pelagic diatom community, dominated by *Chaetoceros socialis*, *Nitzschia delicatissima* and *Thalassiosira nordenskiöldii*, occurred in the deep layer, with primary productivity varing from 0.7-21.2 mg C m^{-3} hr^{-1} and chlorophyll

a concentration from 0.7-7.4 mg m^{-3}. 2) A flagellate community, dominated by *Dinobryon balticum*, *Monosiga marina*, and *Platymonas* sp., occurred in the brackish surface water, with primary productivity varying from 0.0-1.0 mg C m^{-3} hr^{-1} and Chlorophyll *a* concentration from 0.2-1.7 mg m^{-3}. 3) The third community occurred inside Prudhoe Bay during late July 1971, and consisted mainly of pennate diatoms. Its primary productivity varied from 1.3-12.3 mg C m^{-3} hr^{-1} and chlorophyll *a* concentration from 0.8-3.6 mg m^{-3}. The pennates may have been benthic species suspended in the water column by turbulence or ice algae sloughed from the bottom ice layer during melt.

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APPENDICES

APPENDIX I

Station summary sheets

All depths are in meters

Spring Sampling

27 March and 10 May 1971

1. 27 March 1971.

Reindeer Island

	S°/oo	Nutrients (μg-atoms liter^{-1})					Chl. *a*
		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}
Top ice	8.58	0.2	1.0	0.1	1.5	4.0	7.0
Middle ice	4.57	0.4	0.9	0.1	5.0	2.0	1.5
Bottom ice	4.75	0.3	0.8	0.1	1.0	3.0	5.0
Water	30.47	1.3	3.7	0.1	3.2	17.0	0.9

Prudhoe Bay

	S°/oo	Nutrients (μg-atoms liter^{-1})					Chl. *a*
		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}
Top ice	4.24	0.1	0.3	0.1	1.0	1.0	3.6
Middle ice	4.83	0.1	0.7	0.0	1.2	2.0	1.1
Bottom ice	20.23	0.7	2.2	0.1	2.3	31.0	5.7
Water	57.43	0.8	9.4	0.1	7.9	35.0	1.4

2. 10 May 1971. Weather: clear, sunny, no wind.

Reindeer Island

Air temp. -4.5°C | Snow depth: 8 cm
Water temp. -2.0°C | Core length: 152 cm

	S°/oo	Nutrients (μg-atoms liter^{-1})					Chl. *a*
		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}
Top ice	8.43	0.2	0.5	0.1		2.9	3.9
Middle ice	6.91	0.2	0.4	0.0		2.1	0.7
Bottom ice	22.35	1.3	2.4	0.1		5.2	97.9
Water	32.08	0.1	3.9	0.1		15.0	3.9

Prudhoe Bay

Air temp. -5.0°C | Snow depth: 18 cm
Water temp. -4.2°C | Core length: 185 cm

	S°/oo	Nutrients (μg-atoms liter^{-1})					Chl. *a*
		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}
Top ice	5.06	0.1	0.4	0.1		1.8	3.0
Middle ice	5.87	0.1	0.7	0.0		2.8	1.3
Bottom ice	18.37	0.3	2.7	0.1		11.8	1.7
Water	72.08	1.2	10.2	0.3		20.2	0.6

Cruise I

24 - 29 July 1971

1. 24 July 1971. Weather: cloudy, foggy, wet, strong wind from N.E.

Station Number	Station Depth	Secchi Depth	Temp. °C Air	Temp. °C H_2O	Sample Depth	S°/∘∘	Nutrients (µg-atoms liter^{-1}) PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	Chl. *a* mg m^{-3}	Total CO_2	Prim. Prod. mg C m^{-3} hr^{-1}
PB 1	2.3	0.8	5	6	0	21.55	0.4	0.4	0.1	2.7		1.3	2.04	1.4
PB 1					2.0	21.83	0.4	0.4	0.1	12.0	1.0	2.04	2.3	
PB 2	2.0	0.8	5	6	1.5	19.56	0.4	0.3	0.1	1.4	13.5	1.0		
PB 3	1.5	0.8	5	7	0.8	20.06	0.4	0.4	0.1	1.7	15.0	1.0		
PB 4	2.0	0.5	4	7	1.0	17.58	0.2	0.8	0.1	1.6	17.3	1.2		
PB 5	2.5	0.8	4	8	0	19.12	0.2	0.4	0.1	1.4	13.6	0.8	2.04	1.3
PB 5					2.0	21.07	0.2	0.2	0.1	1.6	8.5	1.3	2.05	8.0

2. 25 July 1971. Weather: cloudy, foggy, strong wind from N.E.

Station Number	Station Depth	Secchi Depth	Temp. °C Air	Temp. °C H_2O	Sample Depth	S°/∘∘	Nutrients (µg-atoms liter^{-1}) PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	Chl. *a* mg m^{-3}	Total CO_2	Prim. Prod. mg C m^{-3} hr^{-1}
PB 6	2.0	0.5	6	8	1.5	19.76	0.3	0.4	0.1	1.6	13.8	2.9	2.09	12.3
PB 7	2.0	0.5	6	8	1.5	18.40	0.3	0.3	0.1	1.5	14.7	1.7		

3. 26 July 1971. Weather: foggy but clearing to partly cloudy, slight wind to E.N.E.

Station Number	Station Depth	Secchi Depth	Temp. °C Air	Temp. °C H_2O	Sample Depth	S°/∘∘	Nutrients (µg-atoms liter^{-1}) PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	Chl. *a* mg m^{-3}	Total CO_2	Prim. Prod. mg C m^{-3} hr^{-1}
PB 8	2.5	0.3	5	8	1.5	13.02	0.3	0.3	0.1	1.8	14.8	3.6	2.12	6.5
PB 9	1.8	0.3	7	8	1.5	6.86	0.1	2.7	0.1		27.0	1.6		
PB 10	1.0	0.3	6	8	0	5.46	0.2	2.7	0.1		28.3	1.5	2.02	3.9
PB 11	0.5	0.3	7	8	0	11.46	0.1	2.2	0.1		25.8	1.6		

4. 28 July 1971. Weather: cloudy, occasional rain, light wind from N.

Station Number	Station Depth	Secchi Depth	Temp. °C Air	Temp. °C H_2O	Sample Depth	S°/₀₀	Nutrients (µg-atoms liter^{-1}) PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	Chl. *a* mg m^{-3}	Total CO_2	Prim. Prod. mg C m^{-3} hr^{-1}
PB 12	4.0	3.5	6	5	0	24.33	0.5	0.0	0.1		6.1	0.1	1.87	0.4
PB 12					3.5	31.17	0.8	0.1	0.1		6.8	7.4	2.22	21.2
PB 13	4.0	4.0	4	2	0	18.07	0.4	0.1	0.1		5.8	0.5		
PB 13					3.5	24.37	0.6	0.0	0.1		6.2	0.4		
PB 14	4.5	4.5	5	3	0	18.26	0.5	0.1	0.1		6.2	0.5		
PB 14					4.0	25.33	0.7	0.0	0.1		7.1	0.7		
PB 15	5.3	5.3	6	3	0	21.03	0.3	0.2	0.1		6.2	0.5	1.36	0.0
PB 15					4.5	31.67	0.7	0.0	0.1		0.7	1.2	2.09	1.8
PB 16	7.0	5.3	9	4	0	19.74	0.8	0.3	0.1		5.7	0.4		
PB 16					6.0	31.16	0.9	0.1	0.1		6.5	6.6		
PB 17	6.5	4.0		5	0	21.74	0.5	0.2	0.0		5.0	0.2		
PB 17					6.0	29.53	0.9	0.1	0.1		5.4	1.2		
PB 18	5.0	2.5	8	7	0	26.61	0.6	0.1	0.1		6.3	0.4		
PB 18					4.5	25.03	0.7	0.1	0.1		6.1	0.4		

5. 29 July 1971. Weather: partly cloudy, occasional rain, moderate wind from N.

Station Number	Station Depth	Secchi Depth	Temp. °C Air	Temp. °C H_2O	Sample Depth	S°/₀₀	Nutrients (µg-atoms liter^{-1}) PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	Chl. *a* mg m^{-3}	Total CO_2	Prim. Prod. mg C m^{-3} hr^{-1}
PB 19	6.0	4.0	12	4	0	22.15	0.5	0.1	0.1		6.0	0.3		
PB 19					5.5	28.65	0.7	0.0	0.1		5.4	0.8		
PB 20	2.3	2.0	11	6	1.5	25.68	0.7	0.1	0.1		7.0	0.6		
PB 21	1.5	0.5	8	7	1.0	25.70	0.5	0.1	0.1		7.4	1.4		
PB 22	2.3	1.5	5	7	1.5	24.46	0.7	0.1	0.1		6.2	0.5	1.87	0.2

Cruise II

15 - 19 August 1971

1. 15 August 1971. Weather: clear and sunny, moderate wind from E.N.E.

Station Number	Station Depth	Secchi Depth	Temp. °C Air	H_2O	Sample Depth	S°/₀₀	Nutrients (µg-atoms $liter^{-1}$) PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	Chl. *a* mg m^{-3}	Total CO_2	Prim. Prod. mg C m^{-3} hr^{-1}
PB 101	5.0	3.5	7	5	0	17.73	0.3	0.1	0.1		7.1	0.4	1.54	1.0
PB 101					4.5	17.86	0.3	0.1	0.1		5.8	0.6	1.52	0.6
PB 102	5.0	4.0	5	4	0	18.40	0.4	0.1	0.1		7.5	0.7		
PB 102					4.5	18.45	0.3	0.1	0.1		7.5	0.4		
PB 103	4.5	5.5	5	5	0	18.46	0.3	0.1	0.1		7.4	0.5		
PB 103					4.0	18.50	0.3	0.1	0.1		7.7	0.5		
PB 104	5.5	4.0	7	5	0	18.35	0.4	0.1	0.1		7.5	0.3	1.55	0.3
PB 104					5.0	25.85	0.6	0.1	0.1		8.2	0.9	1.95	0.7
PB 105	6.0	3.5	8	5	0	18.35	0.3	0.0	0.1		6.0	0.4		
PB 105					4.5	19.23	0.4	0.1	0.1		7.6	0.7		
PB 106	6.0	5.0	5	4	0	19.01	0.3	0.2	0.0		6.2	0.6		
PB 106					5.5	19.39	0.4	0.1	0.1		7.1	0.7		

2. 16 August 1971. Weather: warm, sunny, calm.

Station Number	Station Depth	Secchi Depth	Temp. °C Air	H_2O	Sample Depth	S°/₀₀	Nutrients (µg-atoms $liter^{-1}$) PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	Chl. *a* mg m^{-3}	Total CO_2	Prim. Prod. mg C m^{-3} hr^{-1}
PB 107	10.0	2.5	6	5	0	17.90	0.3	0.1	0.1		6.1	0.5	1.57	0.6
PB 107					9.5	30.42	0.8	0.2	0.1		7.5	0.7	2.16	1.3
PB 108	7.0	3.0	11	6	0	16.92	0.2	0.1	0.1		7.1	0.5		
PB 108					6.5	30.12	0.7	0.1	0.1		6.5	0.7		
PB 109	6.0	3.5	14	6	0	17.27	0.3	0.1	0.1		8.6	0.6		
PB 109					5.5	24.45	0.6	0.2	0.1		7.0	0.4		
PB 110	5.0	2.0	14	6	0	16.13	0.3	0.1	0.1		9.3	0.7		
PB 110					4.5	18.34	0.2	0.1	0.1		4.8	0.7		
PB 111	2.8	1.5	18	6	1.5	16.10	0.2	0.2	0.1		1.0	0.6		

3. 17 August 1971. Weather: partly cloudy, calm breeze from E.

Station	Station	Secchi	Temp. °C		Sample	S‰	Nutrients (μ-atoms liter^{-1})					Chl. *a*	Total	Prim. Prod.
Number	Depth	Depth	Air	H_2O	Depth		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}	CO_2	mg C m^{-3} hr^{-1}
PB 112	2.5	1.0	14	9	1.0	13.90	0.1	0.2	0.1		16.3	1.0	1.89	1.4
PB 113	2.5	1.0	14	8	1.0	14.59	0.1	0.2	0.1		11.4	1.2		
PB 114	2.5	1.0	14	8	1.0	13.52	0.1	0.2	0.1		16.3	0.9		
PB 115	1.3	0.5		9	0	14.57	0.3	0.2	0.1		12.8	1.3		
PB 116	1.3	0.8	13	7	0	15.79	0.3	0.2	0.1		10.2	0.9		

4. 18 August 1971. Weather: partly sunny, slight breeze from W.S.W. changing to E.N.E.

Station	Station	Secchi	Temp. °C		Sample	S‰	Nutrients (μg-atoms liter^{-1})					Chl. *a*	Total	Prim. Prod.
Number	Depth	Depth	Air	H_2O	Depth		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}	CO_2	mg C m^{-3} hr^{-1}
PB 117	4.0	4.0	7	4	0	19.13	0.3	0.2	0.1		5.0	0.3	1.45	0.2
PB 117					3.5	20.30	0.5	0.1	0.1		5.5	0.5	1.59	0.3
PB 118	6.0	5.5	8	4	0	18.61	0.4	0.2	0.1		4.6	6.0		
PB 118					5.5	22.40	0.6	0.2	0.1		5.4	0.5		
PB 119	9.5	5.5	7	5	0	18.76	0.4	0.2	0.1		0.5	0.5	1.46	0.1
PB 119					9.0	30.09	0.8	0.2	0.1		4.5	1.3	2.15	0.7
PB 120	8.5	6.5	5	4	0	18.78	0.4	0.2	0.6		5.9	0.5		
PB 120					8.0	30.32	0.8	0.2	0.1		5.7	0.9		
PB 121	7.5	7.5	4	5	0	18.89	0.4	0.2	0.1		6.5	0.6		
PB 121					7.0	25.91	0.6	0.2	0.1		3.4	0.4		

5. 19 August 1971. Weather: partly cloudy, cold, light wind, fog.

Station	Station	Secchi	Temp. °C		Sample	S‰	Nutrients (μg-atoms liter^{-1})					Chl. *a*	Total	Prim. Prod.
Number	Depth	Depth	Air	H_2O	Depth		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}	CO_2	mg C m^{-3} hr^{-1}
PB 122	8.0	5.0	8	3	0	20.35	0.4	0.1	0.1		5.5	0.6	1.57	0.4
PB 122					7.5	26.83	0.7	0.2	0.1		4.2	0.5	1.95	0.4
PB 123	5.0	5.0	5	5	0	18.99	0.3	0.0	0.1		6.8	0.4	1.5.	0.4
PB 123					4.5	24.83	0.6	0.1	0.1		4.8	0.3	1.84	0.4
PB 124	7.0	4.0	5	5	0	18.23	0.3	0.1	0.1		7.6	0.5		
PB 124					6.5	24.61	0.6	0.1	0.1		5.5	1.0		
PB 125	3.0	3.0	5	4	1.5	18.76	0.4	0.0	0.1		7.1	0.5		

Spring Sampling

2 February, 18 May and 25 May, 1972

1. 2 February 1972. Weather: clear cold.

Reindeer Island

Air temp.	-30°C					Snow depth:	4 cm
Water temp.	-1.8°C					Core length:	85 cm

	S°/₀₀	Nutrients (µg-atoms liter^{-1})					Chl. *a*
		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}
Top ice	6.04	0.2	1.4	0.1	2.9	3.0	0.8
Middle ice	7.06	0.2	1.3	0.1	6.0	3.0	2.2
Bottom ice	5.45	0.2	1.1	0.1	3.4	2.0	2.1
Water	35.48	1.4	6.9	0.1	2.5	15.1	0.4

Prudhoe Bay

Air temp.	-31°C					Snow depth:	15 cm
Water temp.	-3.0°C					Core length:	110 cm

	S°/₀₀	Nutrients (µg-atoms liter^{-1})					Chl. *a*
		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}
Top ice	5.23	0.2	0.4	0.0	3.3	1.0	1.6
Middle ice	5.13	0.2	0.5	0.1	4.2	0.9	1.1
Bottom ice	5.95	0.1	2.5	0.1	4.7	2.1	2.1
Water	45.03	1.6	7.5	0.3	2.3	23.3	1.4

2. 18 May 1972. Weather: overcast, high wind from N.E.

Reindeer Island

Air temp. -10.5°C Snow depth: 20 cm Core length: 187 cm

	S°/∘∘	Nutrients (µg-atoms liter^{-1})					Chl. a
		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}
Top ice	5.14	4.0	0.1	0.0	1.3	1.6	0.3
Middle ice	5.42	2.0	0.4	0.0	1.3	2.1	0.3
Bottom ice	5.71	0.2	0.3	0.0	1.6	1.1	7.2
Water	30.58	0.8	0.8	0.1	1.5	7.5	1.7

Prudhoe Bay

Air temp. -9.0°C Snow depth: 30 cm Core length: 184 cm

	S°/∘∘	Nutrients (µg-atoms liter^{-1})					Chl. a
		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}
Top ice	3.99	1.1	0.1	0.0	1.7	0.5	0.6
Middle ice	5.83	0.2	0.0	0.2	1.3	0.5	0.5
Bottom ice	11.74	0.2	1.2	0.6	2.2	5.5	1.5
Water	66.11	0.8	5.1	0.2	1.5	28.6	1.1

3. 25 May 1972. Weather: clear, 20 knt wind from N.E.

Reindeer Island

Air temp. -6.0°C — Snow depth: 24 cm

Water temp. -2.0°C — Core length 172 cm

	S°/oo	Nutrients (μg-atoms liter^{-1})					Chl. *a*
		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}
Top ice	6.52	5.0	1.9	1.7	1.4	3.7	0.8
Middle ice	5.29	2.1	0.4	1.0	1.4	1.5	0.7
Bottom ice	5.66	0.1	0.3	0.0	1.6	1.2	4.5
Water	28.80	0.9	1.0	0.1	1.1	9.3	2.6

Prudhoe Bay

Air temp. -5.0°C — Snow depth: 25 cm

Water temp. -4.0°C — Core length: 189 cm

	S°/oo	Nutrients (μg-atoms liter^{-1})					Chl. *a*
		PO_4-P	NO_3-N	NO_2-N	NH_3-N	SiO_4-Si	mg m^{-3}
Top ice	4.20	0.9	0.7	2.0	1.3	2.5	0.8
Middle ice	8.14	2.1	1.1	2.2	1.4	2.9	0.8
Bottom ice	13.40	0.4	1.2	0.0	2.0	6.3	19.0
Water	66.27	0.8	2.0	1.1	1.1	24.3	2.8

Cruise III

11 - 15 August 1972

The chlorophyll results are from the UNESCO determinations.

1. 11 August 1972. Weather: moderate wind, cloudy, rainy.

Station Number	Station Depth	Secchi Depth	Sample Depth	Temp. °C H_2O	S°/₀₀	Nutrients (µg-atoms liter^{-1}) PO_4-P	NO_3 + NO_2-N	NH_3-N	SiO_4-Si	Chl. *a* mg m^{-3}	Total CO_2	Prim. Prod. mg C m^{-3} hr^{-1}
PB 201	2.8	1.0	1.0			0.4	0.3	0.6	9.0	0.7 1.1		
PB 202	2.5	1.0	1.0			0.4	0.1	0.3	7.7	1.0 1.1		
PB 203	2.5	1.0	0.3	7.4	20.15	0.4	0.3	0.3	8.8	1.1 0.9	1.88	0.9
PB 204	2.3	0.7	1.0			0.3	0.3	0.9	9.4	2.6 1.6		
PB 205a	2.5	0.8	1.0	8.3	19.10	0.5	0.4	1.5	11.0	2.1 1.4		
PB 207	2.5	1.0	1.0			0.4	0.1	0.2	7.7	0.7 0.9		
PB 208	3.0	1.0	1.0	7.6	19.30	0.5	0.4	0.6	9.3	0.7 0.7	1.86	0.4
PB 209	2.1	1.3	1.0	7.4	19.29	0.6	0.3	0.7	9.6	0.4 0.4		

2. 12 August 1972. Weather: partly sunny, high waves, patchy fog, wind from N.E.

Station Number	Station Depth	Secchi Depth	Sample Depth	Temp. °C H_2O	S°/₀₀	Nutrients (µg-atoms liter^{-1}) PO_4-P	NO_3 + NO_2-N	NH_3-N	SiO_4-Si	Chl. *a* mg m^{-3}	Total CO_2	Prim. Prod. mg C m^{-3} hr^{-1}
PB 206	2.0	1.5	1.0	7.8	18.80	0.3	0.3	1.7	10.1	0.6 0.4	1.82	0.4
PB 210	1.0	-	0	7.2	19.30	0.4	0.5	1.3	10.3	0.9 1.0	1.79	1.0
PB 221	1.3	-	0	7.2	19.55	0.4	0.4	0.9	9.6	1.0 1.2		
PB 223	1.2	1.0	1.0	8.2	19.01	0.2	0.6	0.5	11.0	1.6 1.7	1.90	0.6
PB 224	1.5	-	0	6.4	19.68	0.3	0.2	0.2	9.2	1.0 0.9		
PB 225	1.8	-	0	5.5	19.71	0.4	0.5	1.2	8.5	0.9 0.8		
PB 227	1.3	-	0	7.3	18.80	0.3	0.4	0.5	10.6	1.8 1.5		

3. 13 August 1972. Weather: cloudy, foggy, rain, wind from N.E.

Station Number	Station Depth	Secchi Depth	Sample Depth	Temp. °C H_2O	S°/₀₀	Nutrients (µg-atoms $liter^{-1}$) PO_4-P	$NO_3 + NO_2$-N	NH_3-N	SiO_4-Si	Chl. *a* mg m^{-3}	Total CO_2	Prim. Prod. mg C m^{-3} hr^{-1}
PB 205b	2.5	1.0	1.0	6.7	16.76	0.3	0.8	0.9	16.9	1.3	1.86	0.9
										1.2		

4. 14 August 1972. Weather: cloudy, patchy fog, wind from N.

Station Number	Station Depth	Secchi Depth	Sample Depth	Temp. °C H_2O	S°/₀₀	Nutrients (µg-atoms $liter^{-1}$) PO_4-P	$NO_3 + NO_2$-N	NH_3-N	SiO_4-Si	Chl. *a* mg m^{-3}	Total CO_2	Prim. Prod. mg C m^{-3} hr^{-1}
PB 216	6.5	2.5	0		20.49	0.5	0.5	1.1	9.3	0.6		
PB 216			5.0		20.54	0.6	0.3	7.2	9.0	1.3		
PB 219	7.0	1.5	0		20.29	0.6	0.2	0.7	9.0	1.5		
PB 219			5.0		20.62	0.5	0.3	0.6	8.1	0.9		

5. 15 August 1972. Weather: Foggy in morning, sunny later, light variable wind.

Station Number	Station Depth	Secchi Depth	Sample Depth	Temp. °C H_2O	S°/₀₀	Nutrients (µg-atoms $liter^{-1}$) PO_4-P	$NO_3 + NO_2$-N	NH_3-N	SiO_4-Si	Chl. *a* mg m^{-3}	Total CO_2	Prim. Prod. mg C m^{-3} hr^{-1}
PB 212	4.5	2.0	0	3.4	20.73	0.5	0.6	4.1	7.8	0.9	1.74	0.5
PB 212			4.0	2.8	21.11	0.4	0.3	0.4	6.8	0.3	1.73	0.4
PB 213	10.0	3.5	0	2.8	21.26	0.5	0.3	0.0	7.0	0.6	1.78	0.8
PB 213			8.0	sub 0	30.42	0.9	0.4	1.0	5.8	3.3	1.79	2.4
PB 215	11.0	3.5	0	2.8	20.88	0.5	0.3	0.7	7.1	0.7		
PB 215			8.0	sub 0	30.52	0.8	0.4	0.4	5.9	3.8		
PB 217	6.5	2.0	0	4.4	20.30	0.5	0.3	0.7	8.7	1.1	1.70	1.0
PB 217			5.0	0.6	25.75	0.6	0.4	0.8	6.4	1.4	1.90	2.1
PB 218	4.0	1.5	0	4.4	19.90	0.4	0.4	0.6	9.5	1.4		
PB 218			4.0	4.4	19.90	0.4	0.3	0.7	9.7	1.3		

APPENDIX II

Phytoplankton Standing Stock Summary Sheets

The number above each figure is the length of the apical axis of the diatoms, or the cell length of the flagellates. The number beside the figures is the length of the transapical or pervalvar axis of the diatoms, and the cell diameter of the flagellates.

The number of cells counted for each concentration is indicative of the precision of the estimate (Lund et al. 1958). The data in Tables 1, 2, and 48 were obtained by counting a series of fields across the center of the chamber (section 2.4). Therefore the number of cells counted of each species has been listed. The number of cells counted in the 50-ml and 25-ml chambers can be determined by dividing the cell concentration by 20 or 40 respectively. The number of cells counted in the 5-ml chambers can be determined by dividing the cell concentration by 400, with the exception of Tables 52-A, 53-A, 57-A, and 71-A, where the cell concentration should be divided by 600.

Spring Sampling, 1971

Table 1

Reindeer Island, 10-V-71, Bottom Ice, 5 ml, 500 X

Diatoms

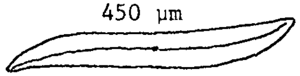
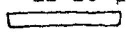
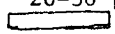
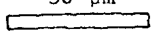
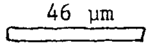
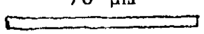
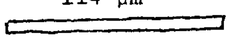
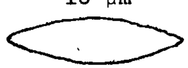
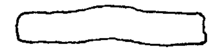
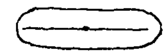
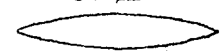
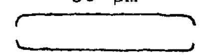
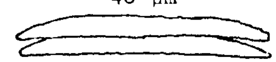
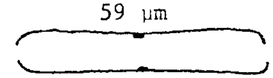
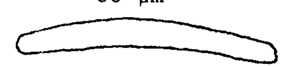
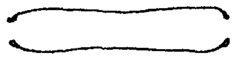
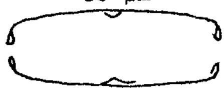
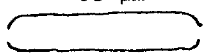
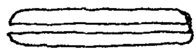
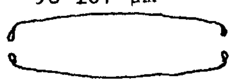
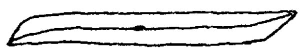
Taxon	Width	Length / Drawing	Cells counted	Cells liter^{-1}
Chaetoceros septentrionalis			5	555,600
Cylindrotheca closterium			8	888,900
Gomphonema exiguum			2	222,200
Gyro-Pleurosigma sp.				
	36 µm	450 µm 	2	222,200
Fragilariopsis spp.				
	5 µm	12-20 µm 	101	11,222,200
	6 µm	20-30 µm 	255	28,333,300
	7 µm	36 µm 	127	14,111,100
	4 µm	46 µm 	58	6,444,400
	5 µm	70 µm 	54	6,000,000
	3 µm	114 µm 	1	111,100
Navicula directa			1	111,100
Navicula valida			1	111,100
Nitzschia frigida			67	7,444,400
	7 µm	18 µm 	1	111,100
	9 µm	27 µm 	4	444,400
	9 µm	27 µm 	1	111,100
	4 µm	30 µm 	1	111,100
	2 µm	34 µm 	1	111,100
	11 µm	36 µm 	1	111,100
	11 µm	45 µm 	1	111,100
	4 µm	48 µm 	1	333,300
	18 µm	59 µm 	1	111,100
	5 µm	60 µm 	2	222,200

Table 1 (continued)

Diatoms (continued)

		Cells counted	Cells liter^{-1}
5 µm	60 µm 	1	111,100
16 µm	67 µm 	2	222,200
9 µm	74 µm 	1	111,100
28 µm	80 µm 	1	111,100
9 µm	83 µm 	4	444,400
12 µm	98 µm 	2	222,200
16-28 µm	98-107 µm 	2	222,200
4 µm	107 µm 	6	666,600
3 µm	300 µm 	5	555,500

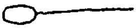
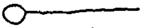
	Cells counted	cells liter^{-1}
Dinoflagellates		
27 µm (length), 7 µm (width) 	2	222,200
Cryptophytes		
9 µm (length), 5 µm (width) 	1	111,100
Prasinophytes		
10 µm 	2	222,200
Unidentified Flagellates		
3 µm 	1	111,100
9 µm 	6	666,600
9 µm 	6	666,600
Unknown		
7 µm 	1	111,100
11 µm 	3	333,300
18 µm 	4	444,400
27 µm 	2	222,200

Table 2

Reindeer Island, 10-V-71, Water with Slush, 5 ml, 500 X

Diatoms

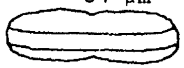
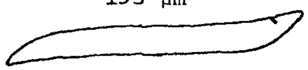
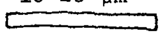
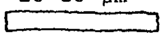
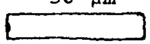
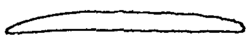
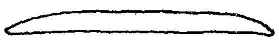
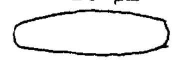
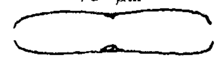
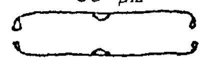
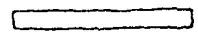
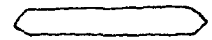
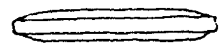
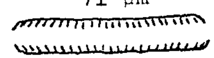
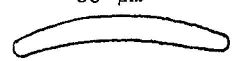
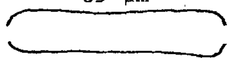
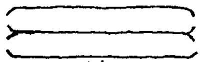
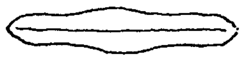
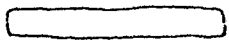
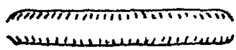
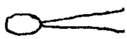
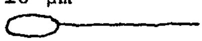
Taxon	Width	Length	Cells counted	Cells liter^{-1}
Amphiprora sp.				
	32 µm	84 µm 	1	12,800
Chaetoceros septentrionalis			2	25,600
Cylindrotheca closterium			1	12,800
Gomphonema exiguum			8	102,500
Gyro-Pleurosigma sp.				
	9 µm	153 µm 	1	12,800
Fragilariopsis spp.				
	4 µm	10-20 µm 	23	358,700
	5 µm	20-30 µm 	227	2,908,400
	4 µm	36 µm 	25	320,300
	5 µm	40-50 µm 	92	1,178,700
	4 µm	52-59 µm 	15	192,200
Navicula sibirica			1	12,800
Navicula valida Cleve & Grunow			1	12,800
Nitzschia frigida			154	1,973,100
	7 µm	27 µm 	1	12,800
	14 µm	28 µm 	1	12,800
	10 µm	48 µm 	1	12,800
	18 µm	60 µm 	1	12,800
	5 µm	60 µm 	3	38,400
	4 µm	69 µm 	1	12,800
		71 µm 	1	12,800
	7 µm	71 µm 	1	12,800
	9 µm	80 µm 	1	12,800

Table 2 (continued)

		Cells counted	Cells $liter^{-1}$
Diatoms (continued)			
9 µm	85 µm 	25	320,300
5 µm	94 µm 	2	25,600
12 µm	94 µm 	1	12,800
5 µm	111 µm 	1	12,800
10 µm	154 µm 	3	38,400
Flagellates			
Platymonas sp. 7 µm		2	25,600
4 µm		1	12,800
5 µm	10 µm 	1	12,800
16 µm		2	25,600

Unknown

		Cells counted	Cells liter^{-1}
7-10 μm		3	38,400
10 μm		1	12,800
12 μm		2	25,600
18 μm		3	38,400
23 μm		3	38,400

Cruise I

24 - 29 July 1971

Table 3

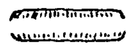
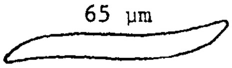
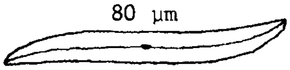
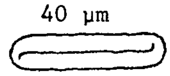
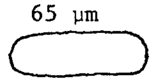
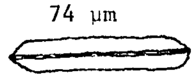
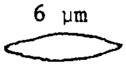
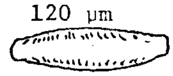
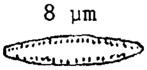
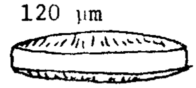
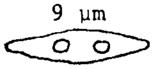
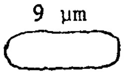
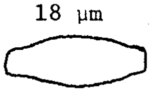
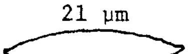
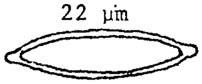
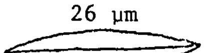
PB 6, 1.5 m depth, 5 ml, 400 X			
Diatoms	Cells liter^{-1}	Diatoms	Cells liter^{-1}
Cylindrotheca closterium	2,400	30 µm 	9,200
Gyro-Pleurosigma sp.			
65 µm 	1,600	30 µm 	4,400
80 µm 	400	40 µm 	800
Navicula pediculus	400	65 µm 	1,600
Navicula transitans	800	74 µm 	800
6 µm 	800	120 µm 	800
8 µm 	400	120 µm 	800
9 µm 	12,800	Dinoflagellates	
9 µm 	2,000	*Peridinium brevipes*	400
18 µm 	800	Flagellates	
21 µm 	8,400	Euglenoid 23 µm	28,800
22 µm 	800	Unknown	
26 µm 	2,400	15 µm	1,600
		27 µm 	5,200

Table 4

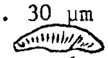
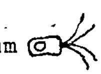
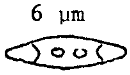
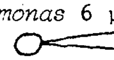
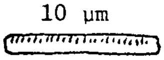
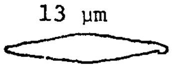
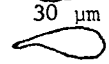
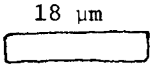
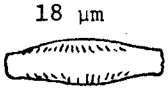
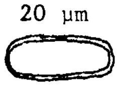
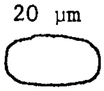
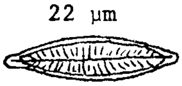
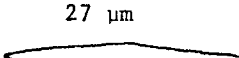
PB 7, 1.5 m depth, 5 ml, 400 X			
Diatoms	Cells liter^{-1}	Dinoflagellates	Cells liter^{-1}
Amphora sp. 30 μm 	400	*Peridinium brevipes*	800
Cylindrotheca closterium	800		
Navicula transitans	9,600	**Flagellates**	
Thalassiosira sp.	1,600		
		Platymonas 6 μm 	400
6 μm 	800	15 μm 	4,000
		Unknown	
10 μm 	400	12 μm 	800
		14 μm 	1,600
		15 μm  spore	400
		17 μm 	4,000
13 μm 	4,400	30 μm 	400
18 μm 	2,400		
18 μm 	1,600		
20 μm 	7,200		
20 μm 	400		
22 μm 	400		
27 μm 	400		

Table 5

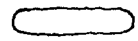
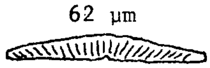
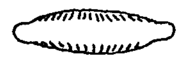
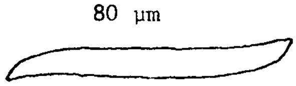
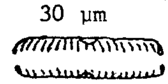
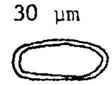
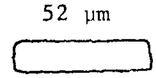
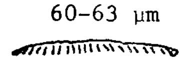
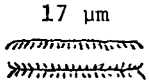
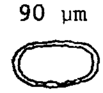
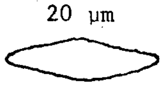
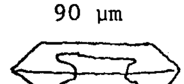
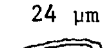
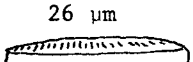
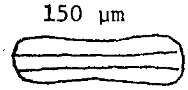
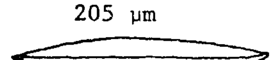
PB 8, 1.5 m depth, 5 ml, 400 X			
Diatoms	Cells liter^{-1}	Diatoms	Cells liter^{-1}
Amphora sp. 23 µm 	1,200	26 µm 	19,200
62 µm 	800	28 µm 	400
Coscinodiscus radiatus	1,600	30 µm 	800
Cylindrotheca closterium	2,400		
Gyro-Pleurosigma sp.			
80 µm 	800	30 µm 	400
Navicula debilissima	400	30 µm 	800
Navicula transitans	17,600		
Thalassiosira sp.	2,000		
8 µm 	2,800	52 µm 	8,000
9 µm 	6,800	60-63 µm 	1,600
17 µm 	2,800	90 µm 	400
20 µm 	1,200	90 µm 	400
24 µm 	2,800	120 µm	800
26 µm 	400	150 µm 	400
		205 µm 	400

Table 5 (continued)

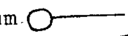
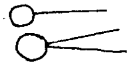
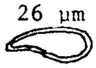
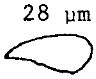
Dinoflagellates	Cells liter^{-1}	Flagellates	Cells liter^{-1}
30 µm 	400	Euglenoid 29 µm	3,600
		6 µm 	400
		12 µm 	1,600
Unknown			
9 µm 	11,600		
15 µm 	8,800		
15 µm  ciliate	1,200		
26 µm 	1,600		
28 µm 	1,600		

Table 6

PB 9, 1.5 m depth, 5 ml, 400 X

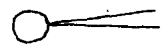
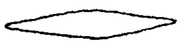
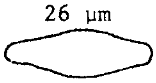
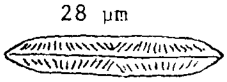
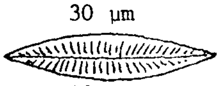
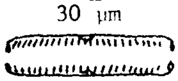
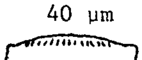
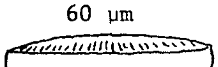
Diatoms	Cells $liter^{-1}$	Flagellates	Cells $liter^{-1}$
Amphora sp.		Euglenoid 26 µm	5,200
23 µm		*Platymonas* sp. 6 µm	400
	1,600	15 µm 	4,000
Cylindrotheca closterium	800		
Gomphonema exiguum	400	Unknown	
Navicula pediculus	400		
Navicula transitans	3,600	15 µm  ciliate	400
5 µm 	400		
9 µm 	2,000		
20 µm 	1,200		
26 µm 	400		
28 µm 	400		
30 µm 	400		
30 µm 	2,000		
40 µm 	400		
60 µm 	2,400		

Table 7

PB 10, 0 m depth, 5 ml, 400 X

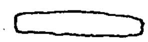
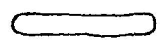
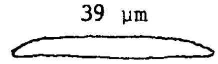
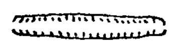
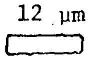
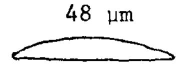
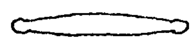
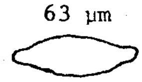
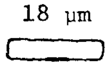
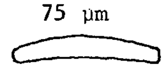
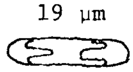
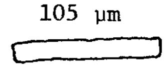
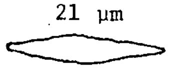
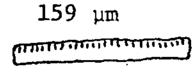
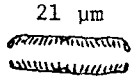
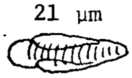
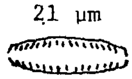
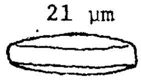
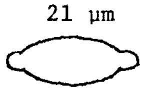
Diatoms	Cells liter^{-1}	Diatoms	Cells liter^{-1}
Amphora sp. 27 µm 	3,600	21 µm 	400
Cylindrotheca closterium	1,600	30 µm 	1,600
Diploneis sp.	400	30 µm 	800
Gomphonema exiguum	400	30 µm 	3,200
Navicula debilissima	400	33 µm 	1,600
Navicula gelida	1,600	39 µm 	800
Navicula transitans	1,200	45 µm 	400
12 µm 	400	48 µm 	400
12 µm 	400	54 µm 	400
15-18 µm 	4,400	63 µm 	400
18 µm 	2,400	75 µm 	1,200
19 µm 	800	105 µm 	400
21 µm 	1,200	159 µm 	400
21 µm 	2,400		
21 µm 	400		
21 µm 	4,000		
21 µm 	1,200		
21 µm 	2,000		

Table 7 (continued)

Flagellates	Cells $liter^{-1}$
Dinobryon balticum	2,000
12 µm	400
16 µm	400
Unknown	
5 µm	7,600
12 µm	1,200
21 µm	400
24 µm	800
27 µm spore	2,800
39 µm	24,000

Table 8

PB 11, 0 m depth, 5 ml, 400 X

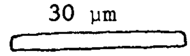
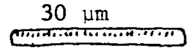
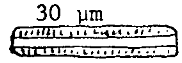
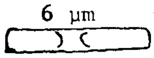
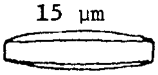
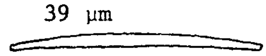
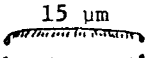
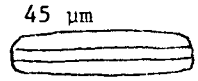
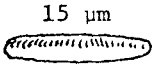
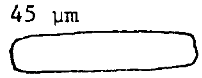
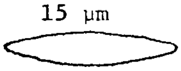
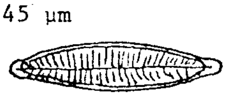
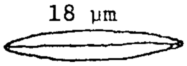
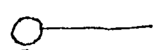
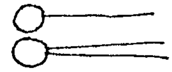
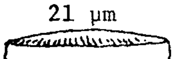
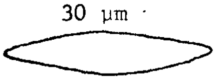
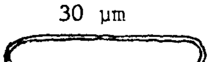
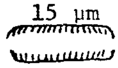
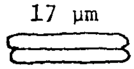
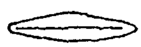
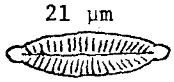
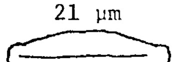
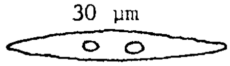
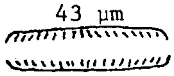
Diatoms	Cells liter^{-1}	Diatoms	Cells liter^{-1}
Amphora sp. 15-21 µm 	2,000	30 µm 	1,600
Chaetoceros socialis	1,200	30 µm 	
Cylindrotheca closterium	800		
Navicula debilissima	800		400
Navicula gelida	800	30 µm 	
Thalassiosira sp.	400		
6 µm 			400
	4,800	30 µm 	
15 µm 			800
	2,400	39 µm 	
15 µm 			400
	2,400	45 µm 	
15 µm 			400
	400	45 µm 	
15 µm 			400
	800	45 µm 	
18 µm 			800
	2,000	Flagellates	
18 µm 		5 µm 	400
	400	15 µm 	1,600
21 µm 			
	400	Unknown	
30 µm 		3 µm colonial	6,000
	800	6-9 µm 	6,800
30 µm 		13 µm 	400
		15 µm 	2,400
	400	15 µm  yellow	400
		30 µm 	400

Table 9-A

PB 12, 0 m depth, 5 ml, 400 X

Diatoms	Cells $liter^{-1}$
Chaetoceros septentrionalis	800
Cylindrotheca closterium	1,200
Navicula pediculus	400
Navicula transitans	400
Nitzschia frigida	1,600
15 µm 	400
17 µm 	800
21 µm 	5,600
21 µm 	400
21 µm 	400
30 µm 	800
43 µm 	400
45 µm 	400

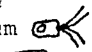
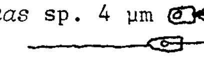
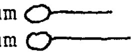
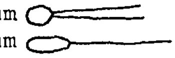
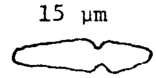
Flagellates	Cells $liter^{-1}$
Dinobryon balticum	16,800
Platymonas sp. 4 µm 	7,600
3 µm 	7,600
3 µm 	1,600
6 µm 	18,400
6 µm 	14,000
12 µm 	38,400
Unknown	
5 µm  spore	27,600
6 µm	18,800
9 µm 	6,000
9 µm 	15,600
15 µm	1,600
24 µm	3,600
Dinoflagellates	
Peridinium minusculum	400
Peridinium pallidum	800
15 µm 	800

Table 9-B

PB 12, 0 m depth, 50 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros subsecundus	20
Nitzschiella acicularis	60

Table 10-A

PB 12, 3.5 m depth, 5 ml, 400 X

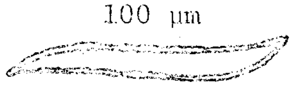
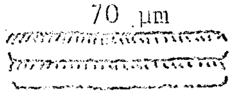
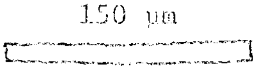
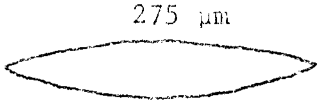
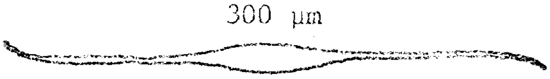
Diatoms	Cells liter^{-1}
Bacterosira fragilis	47,600
Chaetoceros atlanticus	3,200
Chaetoceros socialis	26,800
Coscinodiscus sp.	
45 µm diameter	400
Cylindrotheca closterium	42,000
Fragilariopsis spp.	83,200
7 µm	7,600
20 µm	45,600
40 µm	27,200
45 µm	4,000
Gyro-Pleurosigma spp.	
80 µm	800
225 µm	1,600
Navicula transitans	9,200
Nitzschia delicatissima	2,000
Nitzschiella acicularis	15,200
Porosira glacialis	5,200
Thalassiosira gravida	11,600
Thalassiosira nordenskiöldii	388,800
Thalassiosira sp.	
7 µm	2,800
8 µm	46,000
12 µm	400
15 µm	1,200

Diatoms	Cells liter^{-1}
30 µm	400
30 µm	2,000
80 µm	800
Dinoflagellates	
Goniaulax catenata	400
Gymnodinium lohmanni	3,600
24-30 µm	7,600
Flagellates	
Platymonas sp. 5 µm	3,600
5 µm	19,600
5 µm	11,200
14 µm	14,000

Unknown	Cells liter^{-1}
5 µm	12,400
6 µm spore	30,000
15 µm	60,400
15 µm ciliate	400
45 µm ciliate	400

Table 10-B

PB 12, 3.5 m depth, 50 ml, 100 X

Diatoms	Cells liter^{-1}
Coscinodiscus sp. 75 µm diameter	60
Fragilariopsis sp. 40 µm x 4 µm	17,980
Gyro-Pleurosigma sp.	
100 µm 	100
Navicula directa	180
Navicula transitans	280
Nitzschia delicatissima	420
Nitzschia frigida	40
Nitzschiella acicularis	640
70 µm 	520
150 µm 	260
275 µm 	60
300 µm 	60

Dinoflagellates

Peridinium brevipes	present

Unknown

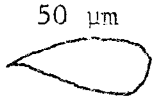
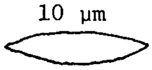
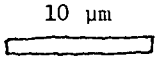
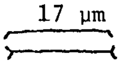
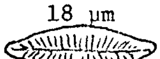
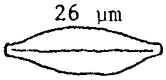
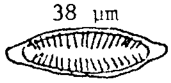
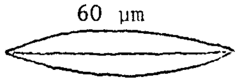
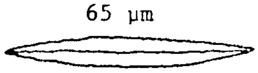
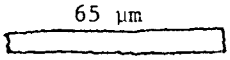
50 µm 	80

Table 11-A

PB 13, 0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Bacterosira fragilis	800
Chaetoceros socialis	200
Fragilariopsis sp.	1,200
Thalassiosira nordenskiöldii	2,000
Thalassiosira sp.	200
10 µm 	400
10 µm 	800
17 µm 	1,400
18 µm 	200
26 µm 	200
38 µm 	200
60 µm 	200
65 µm 	200
65 µm 	1,600

Dinoflagellates	
Goniaulax catenata	2,200
Peridinium minusculum	800
30 µm 	600

Flagellates	Cells liter^{-1}
Distephanus speculum	200
Dinobryon balticum	10,800
Euglenoid 38 µm	200
Platymonas sp. 4 µm	1,600
6 µm	2,900
9 µm	7,400
15 µm	6,600

Unknown	
6 µm spore	22,400
6-9 µm	9,800
17 µm	1,000

Table 11-B

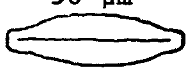
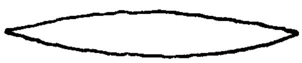
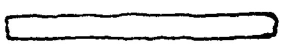
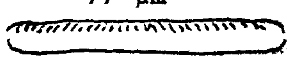
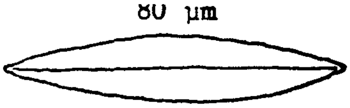
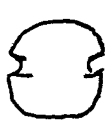
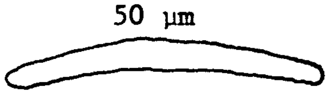
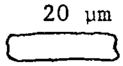
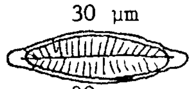
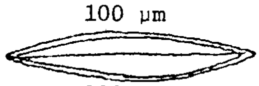
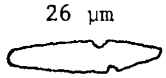
PB 13, 0 m depth, 50 ml. 100 X	
Diatoms	**Cells liter^{-1}**
Navicula transitans	40
Thalassiosira nordenskiöldii	220
50 µm 	400
65 µm 	20
65 µm 	20
77 µm 	100
80 µm 	20
Dinoflagellates	
Goniaulax catenata	860
Peridinium minusculum	200
30 µm 	present
Unknown	
50 µm 	60

Table 12

PB 13, 3.5 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros atlanticus	800
Chaetoceros socialis	800
Cylindrotheca closterium	800
Nitzschiella acicularis	800
Thalassiosira nordenskiöldii	6,400
20 μm 	800
30 μm 	400
30 μm 	400
100 μm 	400
120 μm	400

Dinoflagellates

Dinoflagellates	Cells liter^{-1}
Gymnodinium lohmanni	400
Peridinium pallidum	1,200
26 μm 	1,200
28 μm 	400

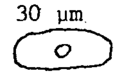
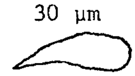
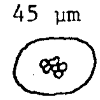
Flagellates	Cells liter^{-1}
Dinobryon balticum	800
Platymonas sp. 6 μm	16,000
3 μm	6,400
4 μm	1,600
4 μm	4,000
6 μm	11,200
7-9 μm	6,800
15 μm	400
Unknown	
5 μm spore	8,800
6 μm spore	800
6-9 μm	16,800
30 μm 	2,400
30 μm  yellow	400
45 μm  yellow	400

Table 13-A

PB 14, 0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros atlanticus	400
Chaetoceros compressus	800
Chaetoceros decipiens	400
Coscinodiscus sp.	400
Cylindrotheca closterium	400
Nitzschiella acicularis	1,200
Thalassiosira nordenskiöldii	3,600
Thalassiosira sp.	1,200
3 µm	400
8 µm	1,200
29-39 µm	1,600
43 µm	2,000
45 µm	400
51 µm	400
73 µm	400

Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	6,000
Gymnodinium lohmanni	400
Peridinium pallidum	400

Flagellates	Cells liter^{-1}
Dinobryon balticum	10,000
Platymonas sp. 6 µm	6,000
3 µm	11,200
3 µm	14,000
6 µm	800
6 µm yellow	3,200
9 µm	14,000
9 µm	2,400
9 µm	4,800
12 µm	5,600

Unknown	Cells liter^{-1}
3 µm	15,600
3 µm spore	400
3 µm yellow	6,800
5 µm spore	15,200
6 µm spore	5,200
6 µm	400
6 µm yellow	6,800
9 µm	15,600
18 µm	400
27 µm yellow	400
30 µm	1,200

Table 13-B

PB 14, 0 m depth, 50 ml, 100 X

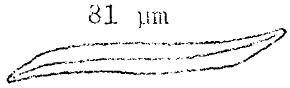
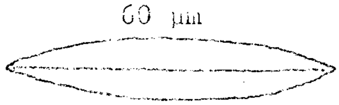
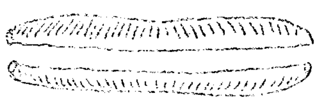
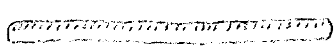
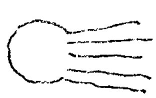
Diatoms	Cells liter^{-1}
Gyro-Pleurosigma sp.	
81 µm 	40
60 µm 	20
65 µm 	40
84 µm 	20
Dinoflagellates	
Peridinium pallidum	present
Unknown	
66 µm 	20

Table 14-A

PB 16, 6.0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros atlanticus	3,600
Chaetoceros compressus	2,400
Chaetoceros decipiens	600
Chaetoceros septentrionalis	1,800
Chaetoceros socialis	1,238,400
Chaetoceros wighami	2,400
Cylindrotheca closterium	27,600
Fragilariopsis spp.	
14 µm; 7 µm	1,200
23 µm; 7 µm	18,600
Melosira juergensi	1,200
Navicula directa	1,800
Navicula gelida	1,800
Nitzschia delicatissima	10,200
Nitzschia frigida	1,200
Porosira glacialis	3,200
Thalassiosira gravida	16,800
Thalassiosira nordenskiöldii	241,200
6 µm	1,200
9 µm; 2 µm	600
14 µm; 5 µm	1,200
21 µm; 9 µm	600
23 µm; 5 µm	6,000
35 µm; 10 µm	600
40 µm; 2 µm	9,000
53 µm; 10 µm	1,200

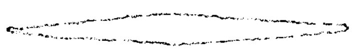
Diatoms	Cells liter^{-1}
60 µm; 3 µm	2,400
80 µm; 2 µm	600
101 µm; 18 µm	600
Dinoflagellates	
Gymnodinium lohmanni	1,800
Peridinium brevipes	600
Peridinium minusculum	1,800
Peridinium pallidum	600
18 µm	3,600
Flagellates	
Dinobryon balticum	600
Ebria tripartita	600
Monosiga marina	1,200
Platymonas sp. 6 µm	3,600
3 µm	600
5 µm	1,800
10 µm	600
12 µm	600
16 µm	600
Unknown	
6 µm spore	600
9 µm spore	1,200
9 µm	3,000
10 µm	600
18 µm	2,400
21 µm	2,400

Table 14-B

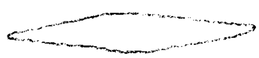
PB 16, 6.0 m depth, 50 ml, 100 X

Diatoms	Cells liter^{-1}
Navicula directa	340
Nitzschia frigida	160
Porosira glacialis	240

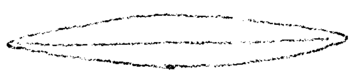
50 m

2 m  320

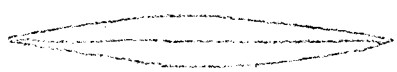
60 m

5 m  20

64 m

7 m  400

94 m

12  60

Dinoflagellates	
Gymnodinium lohmanni	1,200
Peridinium belgicum Wulff	80
Peridinium brevipes	500
Peridinium minusculum	present
Peridinium pallidum	320

Flagellates	
Ebria tripartita	120

Table 15-A

PB 17, 6.0 m depth, 5 ml, 400 X

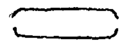
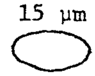
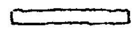
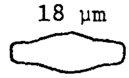
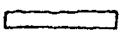
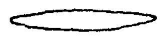
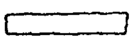
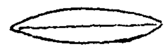
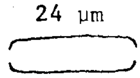
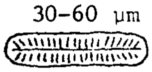
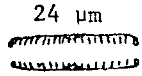
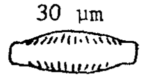
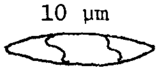
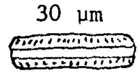
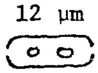
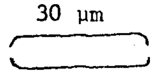
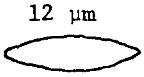
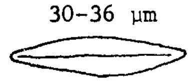
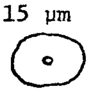
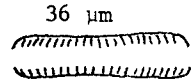
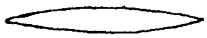
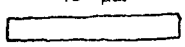
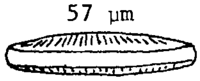
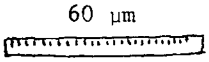
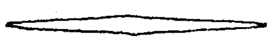
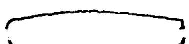
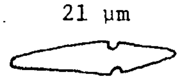
Diatoms	Cells liter^{-1}	Diatoms	Cells liter^{-1}
Amphora sp. 39 µm 	400	15 µm 	9,600
Bacterosira fragilis	800	15 µm  *Ch.* spore	2,400
Chaetoceros atlanticus	400		
Chaetoceros decipiens	400		
Chaetoceros socialis	10,000	18 µm 	1,600
Chaetoceros sp.	4,000		
Cylindrotheca closterium	4,800		
Diploneis sp.	400	18 µm 	1,600
Fragilariopsis spp.			
18 µm, 9 µm 	9,600	21 µm 	5,600
39 µm, 6 µm 	6,800	21 µm 	6,400
Navicula debilissima	7,200	24 µm 	400
Navicula directa	3,200		
Navicula gelida	4,400		
Navicula transitans	800	24 µm 	6,800
Nitzschiella acicularis	5,600		
Pinnularia sp.			
30-60 µm 	800	24 µm 	6,400
Thalassiosira gravida	5,600		
Thalassiosira nordenskiöldii	45,200	27 µm 	400
Thalassiosira sp.	13,600		
9 µm 	16,800	30 µm 	400
10 µm 	3,200	30 µm 	800
12 µm 	5,200	30 µm 	800
12 µm 	3,200	30-36 µm 	1,600
15 µm 	800	36 µm 	400

Table 15-A (continued)

Diatoms	Cells liter^{-1}
45 µm 	400
45 µm 	800
57 µm 	2,800
60 µm 	400
75 µm 	400
135 µm 	800
Dinoflagellates	
Gymnodinium lohmanni	2,000
Peridinium belgicum	2,000
Peridinium brevipes	400
Peridinium minusculum	1,200
Peridinium pallidum	2,800
21 µm 	1,600

Flagellates	Cells liter^{-1}
Dinobryon balticum	2,000
Euglenoid 27 µm	400
Platymonas sp. 6 µm	800
3 µm	4,000
5-6 µm	5,200
6 µm	5,600
9 µm	5,200
15 µm	1,200
Unknown	
5 µm	800
6 µm	25,600
6 µm spore	400
12 µm	20,000
12 µm spore	800
12-15 µm	9,200
18 µm ciliate	400
24 µm	400
60 µm ciliate	400

Table 15-B

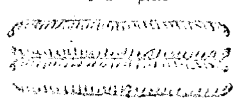
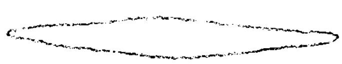
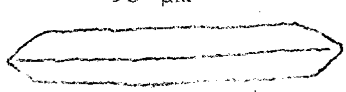
PB 17, 6.0 m depth, 50 ml, 100 X	
Diatoms	Cells liter^{-1}
Navicula directa	420
Navicula gelida	100
Navicula transitans	60
95 µm 	140
95 µm 	60
95 µm 	20

Table 16-A

PB 19, 0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros socialis	400
Cylindrotheca closterium	800
Thalassiosira nordenskiöldii	4,800
18 µm	400
18 µm	400
30 µm	400
42 µm	1,600
60 µm	400
Dinoflagellates	
Goniaulax catenata	400
Peridinium minusculum	400
Peridinium pallidum	400
Peridinium sp.	400

Flagellates	Cells liter^{-1}
Dinobryon balticum	64,000
Platymonas sp. 6 µm	2,400
3 µm	9,600
3 µm	14,800
5 µm yellow	2,400
5 µm	14,000
6 µm	16,800
6 µm	2,000
11 µm	2,800
12 µm	2,000
12 µm yellow	2,400
Unknown	
5 µm	25,200
6 µm	2,000
12 µm	400
21 µm yellow	800
45 µm	400

Table 16-B

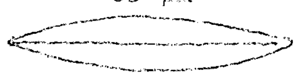
PB 19, 0 m depth, 50 ml, 100 X	
Diatoms	Cells liter^{-1}
65 µm 	20
Dinoflagellates	
Dinophysis arctica	present

Table 17-A

PB 19, 5.5 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros atlanticus	800
Chaetoceros convolutus	400
Chaetoceros decipiens	6,000
Chaetoceros socialis	12,000
Cylindrotheca closterium	1,200
Navicula directa	400
Navicula transitans	800
Thalassiosira gravida	2,400
Thalassiosira nordenskiöldii	7,600
Thalassiosira spp. 30-39 m diameter	1,200
18 μm	400
63 μm	400
69 μm	800

Dinoflagellates	Cells liter^{-1}
Peridinium belgicum	400
Peridinium minusculum	800
Peridinium pallidum	800
15 μm Top view	800
26 μm	2,000

Flagellates	Cells liter^{-1}
Dinobryon balticum	5,600
Platymonas sp. 6 μm	8,000
3 μm	4,800
5 μm	7,200
6 μm	2,700
6 μm	2,800
9 μm	5,200
12 μm	3,200

Unknown	Cells liter^{-1}
3 μm	4,800
6 μm	19,200
6 μm yellow	4,400
12 μm	10,400
12 μm	800
15 μm yellow	800
15 μm ciliate	400
16 μm ciliate	800
24 μm	1,200
45 μm	2,000
54 μm	4,400

Table 17-B

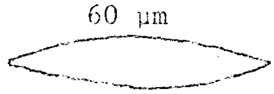
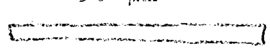
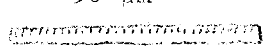
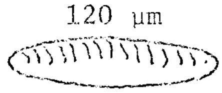
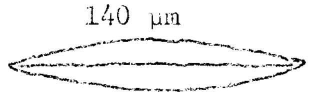
PB 19, 5.5 m depth, 50 ml, 100 X	
Diatoms	Cells liter^{-1}
Cylindrotheca closterium	20
Fragilariopsis spp.	present
Nitzschiella acicularis	460
60 µm 	200
90 µm 	60
90 µm 	60
120 µm 	800
140 µm 	20
Dinoflagellates	
Peridinium pallidum	60

Table 18

PB 20, 1.5 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Achnanthes sp. 21 μm	400
Chaetoceros atlanticus	400
Chaetoceros compressus	800
Chaetoceros decipiens	400
Chaetoceros socialis	2,400
Cylindrotheca closterium	1,600
Navicula debilissima	800
Nitzschiella acicularis	800
Thalassiosira gravida	1,600
Thalassiosira nordenskiöldii	400
15 μm	400
15 μm	400
18 μm	400
21 μm	400
39 μm	400
48 μm	400

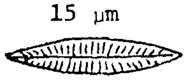
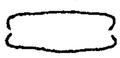
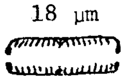
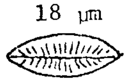
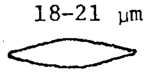
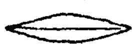
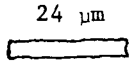
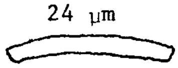
Dinoflagellates	Cells liter^{-1}
Peridinium brevipes	400
Peridinium minusculum	800
Peridinium sp.	1,200

Flagellates	Cells liter^{-1}
Dinobryon balticum	17,600
Euglenoid 27 μm	400
Platymonas sp. 6 μm	4,400
3 μm	2,000
3 μm	6,800
5 μm	400
6 μm yellow	4,000
6 μm yellow	800
6 μm	1,600
6 μm	4,000
16 μm	2,400
16 μm	1,200

Unknown	Cells liter^{-1}
5-8 μm	12,400
12 μm yellow	26,400
15 μm	6,400
15 μm	400
18 μm	400
21 μm	400
21 μm	2,000
24 μm spore	400
45 μm	1,600

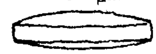
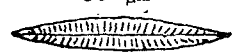
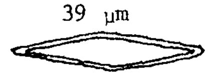
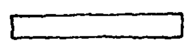
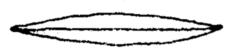
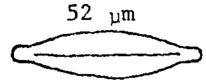
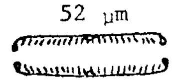
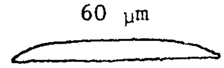
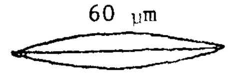
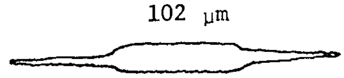
Table 19-A

PB 21, 1.0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros socialis	800
Cylindrotheca closterium	1,600
Navicula debilissima	1,600
Navicula transitans	2,000
Nitzschia sigmoidea	400
Thalassiosira gravida	400
Thalassiosira nordenskiöldii	1,600
Thalassiosira sp.	400
12 μm 	1,200
15 μm 	400
15 μm 	1,200
18 μm 	2,800
18 μm 	400
18-21 μm 	2,000
24 μm 	1,600
24 μm 	400
24 μm 	400

Dinoflagellates

Peridinium belgicum	400
Peridinium pallidum	1,200
Peridinium sp.	400

Diatoms	Cells liter^{-1}
27 μm 	400
29 μm 	800
36 μm 	400
39 μm 	400
52 μm 	1,600
52 μm 	1,600
52 μm 	400
52 μm 	1,200
60 μm 	400
60 μm 	400
102 μm 	400

Flagellates

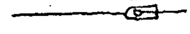
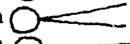
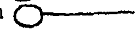
Dinobryon balticum	8,400
Euglenoid 27 μm	1,200
Platymonas sp. 6 μm	2,000
3 μm 	1,200
6 μm 	6,800
6 μm 	6,800
12 μm 	4,400

Table 19-A (continued)

Uuknown	Cells liter^{-1}
3 µm	10,400
6 µm yellow	400
7 µm	800
9 µm	5,600
12 µm	12,800
12 µm	400
12 µm	4,400
12 µm	5,600
18 µm yellow	2,400
18 µm	2,800
21-24 µm	2,400
30 µm yellow	1,600
45 µm yellow	3,600

Table 19-B

PB 21, 1.0 m depth, 50 ml, 100 X

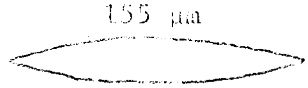
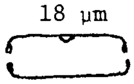
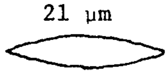
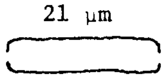
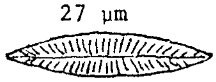
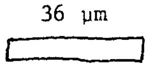
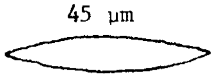
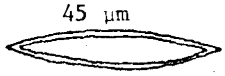
Diatoms	Cells liter^{-1}
155 μm 	400
Dinoflagellates	
Peridinium pallidum	800

Table 20-A

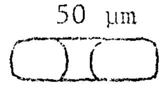
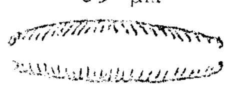
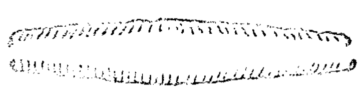
PB 22, 1.5 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}	Flagellates	Cells liter^{-1}
Chaetoceros atlanticus	800	*Dinobryon balticum*	16,000
Chaetoceros decipiens	3,600	Euglenoid 27 μm	400
Cylindrotheca closterium	400	*Platymonas* sp. 6 μm	2,800
Thalassiosira nordenskiöldii	7,600	3 μm	3,600
		3 μm	16,400
18 μm		6 μm	4,800
	1,200	6 μm	2,400
		6 μm	4,000
21 μm		6 μm	2,000
	400	15 μm	1,600
		15 μm	4,000
21 μm			
	1,600	**Unknown**	
27 μm			
	800	6 μm yellow	1,200
		6 μm spore	1,600
36 μm		6-9 μm	20,400
	400	9 μm spore	400
		12 μm spore	400
45 μm		15 μm	800
	400	18 μm	1,600
45 μm		30 μm	800
	400	45 μm	400

Dinoflagellates	
Goniaulax catenata	1,200
Peridinium belgicum	1,200
Peridinium palldium	400

Table 20-B

PB 22, 1.5 m depth, 50 ml, 100 X

Diatoms	Cells $liter^{-1}$
Thalassiosira gravida	100
50 µm 	20
69 µm 	20
135 µm 	40

Cruise II

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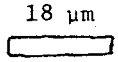
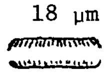
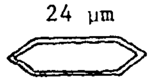
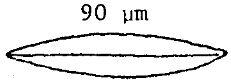
Table 21-A

PB 101, 0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Cylindrotheca closterium	2,000
Nitzschiella acicularis	800
18 μm 	10,400
18 μm 	400
24 μm 	400
90 μm 	400

Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	800
Gymnodinium lohmanni	2,000
Peridinium belgicum	800
Peridinium brevipes	400
Peridinium minusculum	2,000
Peridinium pallidum	400

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	1,200
Dinobryon balticum	85,600
Diaphanoeca grandis	400
Monosiga marina	14,000
Platymonas sp. 6 μm	4,400
3 μm	5,200
3 μm	21,200
6 μm	4,800
6 μm	16,000
6 μm	800
12 μm	2,000
15 μm	400

Unknown	Cells liter^{-1}
4 μm	2,000
6 μm	27,600
6 μm	8,400
9 μm	6,000
12 μm	18,000
12 μm spore	3,600
15 μm	800
15 μm	2,400
75 μm ciliate	400

Table 21-B

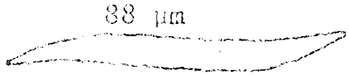
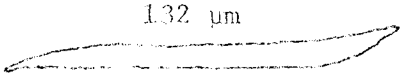
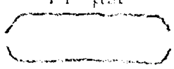
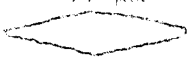
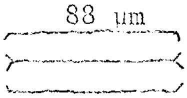
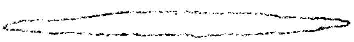
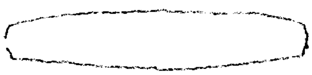
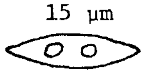
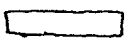
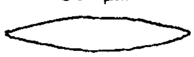
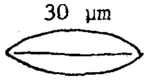
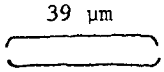
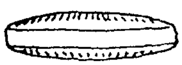
PB 101, 0 m depth, 50 ml, 100 X	
Diatoms	Cells liter^{-1}
Cylindrotheca closterium	100
Gyro-Pleurosigma sp.	
88 µm 	40
132 µm 	40
44 µm 	40
44 µm 	20
88 µm 	80
110 µm 	60
110 µm 	20
Dinoflagellates	
Goniaulax catenata	100
Gymnodinium lohmanni	280
Peridinium brevipes	180
Peridinium minusculum	20
Peridinium pallidum	100

Table 22-A

PB 101, 4.5 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Cylindrotheca closterium	2,800
15 µm 	400
15 µm 	5,600
30 µm 	400
30 µm 	400
39 µm 	800
45 µm 	400

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	22,400
Dinobryon balticum	12,400
D. balticum loricae	49,600
Monosiga marina	4,000
Platymonas sp. 6 µm	11,600
3 µm	4,400
empty	4,000
3 µm	10,000
3 µm	1,600
6 µm	30,600
6 µm	10,000
6 µm	11,600
6 µm	2,000
9 µm	400
9 µm	400
12 µm	2,400
12 µm	400

Dinoflagellates	Cells liter^{-1}
Gymnodinium lohmanni	1,200
Peridinium minusculum	1,200

Unknown	Cells liter^{-1}
3 µm	400
6 µm	9,600
6 µm spore	2,800
6 µm spore	800
9 µm	2,800
9 µm	800
9 µm spore	4,400
12 µm	2,000
12 µm	15,200
15-18 µm	11,200
21 µm	2,800

Table 22-B

PB 101, 4.5 m depth, 50 ml, 400 X

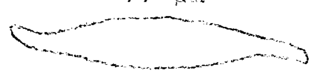
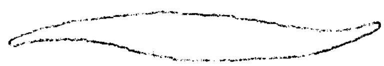
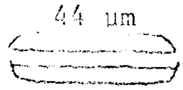
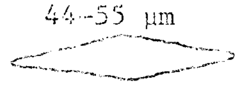
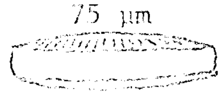
Diatoms	Cells liter
Cylindrotheca closterium	120
Gyro-Pleurosigma spp.	
77 µm 	60
143 µm 	40
Nitzschiella acicularis	40
44 µm 	20
44-55 µm 	60
75 µm 	20
Dinoflagellates	
Goniaulax catenata	180
Gymnodinium lohmanni	200
Peridinium brevipes	200
Peridinium minusculum	140
Peridinium pallidum	100
Flagellates	
Ebria tripartita	40
Unknown	
50 µm  tintinnid	20

Table 23-A

PB 102, 4.5 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Cylindrotheca closterium	2,000
9 µm	400
21 µm	800
27 µm	1,200
36 µm	800
117 µm	400
Dinoflagellates	
Peridinium minusculum	800

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	10,800
Dinobryon balticum	16,400
Ebria tripartita	400
Monosiga marina	12,400
Platymonas sp. 6 µm	24,800
3 µm	2,000
3 µm	5,200
3 µm	4,800
6 µm	19,600
6 µm	7,600
6 µm	3,200
6 µm	3,600
15 µm	2,400
15 µm	1,600
Unknown	
3 µm	400
3 µm	3,600
6 µm spore	1,200
6 µm	24,800
9 µm	6,400
9 µm	1,600
15 µm	30,800
21 µm	800
27 µm	800
30 µm	2,800
45 µm	2,000

Table 23-B

PB 102, 4.5 m depth, 50 ml, 100 X

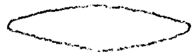
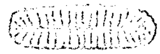
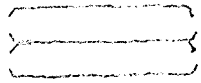
Diatoms	Cells liter
Cylindrotheca closterium	80
Diploneis sp.	40
Navicula transitans	60
44 µm 	20
50 µm 	60
55 µm 	20
75 µm 	40
Dinoflagellates	
Gonyaulax catenata	40
Peridinium brevipes	100
Peridinium minusculum	180
Peridinium pallidum	140
Flagellates	
Ebria tripartita	20
Unknown	
60 µm 	220

Table 24-A

FB 103, 0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros sp.	400
Cylindrotheca closterium	200
12 μm	400
18 μm	400
21 μm	400
30 μm	400
51 μm	400
69 μm	400

Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	400
Peridinium minusculum	1,200
21 μm	400

Flagellates	Cells liter^{-1}
Calycomonas ovalis	800
Calycomonas vangoorii	28,800
Dinobryon balticum	800
D. balticum loricae	115,200
Monosiga marina	25,200
Platymonas sp. 6 μm	36,000
3 μm	4,000
3 μm	12,800
3 μm	2,000
6 μm	4,800
6 μm	1,200
6 μm	9,200
6 μm	20,000
6 μm	2,000
6 μm	4,400
9 μm	1,200
9 μm	400
9 μm	1,200
9 μm	400
12 μm	400
12 μm	400
15 μm	2,400
15 μm	400
Unknown	
3-6 μm	15,200
6 μm spore	10,000
9 μm	4,000
9 μm spore	1,600
9 μm	13,300
12 μm	400
12 μm	400
12 μm spore	400
15 μm	10,000
18 μm	3,600
30 μm ciliate	400
30 μm	1,200

Table 24-B

PB 103, 0 m depth, 50 ml, 100 X

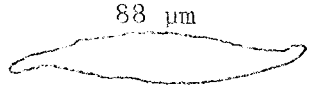
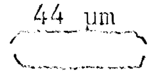
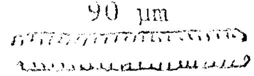
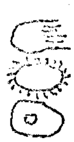
Diatoms	Cells liter
Gyro-Pleurosigma sp.	
88 µm 	20
Navicula directa	60
44 µm 	40
90 µm 	20
Dinoflagellates	
Goniaulax catenata	60
Gymnodinium lohmanni	220
Peridinium brevipes	160
Peridinium minusculum	520
Peridinium pallidum	120
Flagellates	
Ebria tripartita	40
Unknown	
30 µm  ciliate	40
44 µm	20
50 µm	20

Table 25-A

PB 103, 4.0 ml, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Cylindrotheca closterium	400
Navicula debilissima	400
9 µm	400
18 µm	400
30 µm	800

Dinoflagellates	
Peridinium brevipes	400
Peridinium minusculum	400
Peridinium pallidum	800

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	13,600
Dinobryon balticum	4,800
Euglenoid	800
Monosiga marina	21,200
Platymonas sp. 6 µm	30,400
3 µm	3,600
3 µm	8,800
3 µm	1,200
6 µm	26,400
6 µm	1,200
6 µm	12,000
6 µm	1,200
15 µm	2,400
15 µm	1,600
Unknown	
3 µm	6,400
6 µm	29,200
6 µm spore	3,600
6 µm spore	1,200
9 µm spore	2,000
9 µm	400
9 µm	12,800
15 µm	32,800
18 µm	400
18 µm	400
21 µm	2,800

Table 25-B

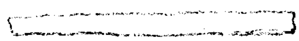
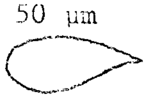
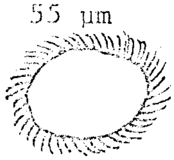
PB 103, 40 m depth, 50 ml, 100 x	
Diatoms	Cells liter
Diploneis sp.	20
55 µm 	20
Dinoflagellates	
Goniaulax catenata	80
Peridinium brevipes	120
Peridinium minusculum	60
Peridinium pallidum	60
Flagellates	
Ebria tripartita	20
Unknown	
50 µm 	140
55 µm  tintinnid	20

Table 26-A

PB 104,	3.0 m depth,	5 ml,	400 X
Diatoms	**Cells liter^{-1}**	**Flagellates**	**Cells liter^{-1}**
Chaetoceros sp.	400	*Calycomonas vangoorii*	15,200
Gyro-Pleurosigma sp. 135 μm	400	*Dinobryon balticum*	12,000
		D. balticum loricae	201,200
		Euglenoid	400
		Platymonas sp. 6 μm	8,400
		3 μm	6,800
15 μm	800	empty	3,200
		3 μm	22,800
		3 μm	8,800
24 μm	800	6 μm	9,200
		6 μm	5,600
		6 μm	13,200
		6 μm	1,200
33 μm	400	9 μm	800
39 μm	400	12 μm	1,600
		Unknown	
Dinoflagellates		3-6 μm	26,400
Gymnodinium lohmanni	400	6 μm	8,800
Peridinium brevipes	400	9 μm spore	800
Peridinium minusculum	800	9 μm	2,000
Peridinium pallidum	400	9 μm spore	1,200
		12 μm spore	2,000
		15 μm	15,600
		15 μm	400
		18 μm	400
		24 μm	400
		45 μm	800
		69 μm ciliate	1,200

Table 26-B

PB 104, 3 m depth, 50 ml, 100 X

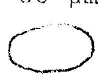
Diatoms	Cells liter^{-1}
Navicula transitans	40
Dinoflagellates	
Gymnodinium lohmanni	60
Peridinium brevipes	60
Peridinium minusculum	120
Peridinium pallidum	360
Unknown	
66 µm 	60

Table 27-A

PB 105, 0 m depth, 5 ml, 400 X			
Diatoms	Cells liter^{-1}	Unknown	Cells liter^{-1}
Cylindrotheca closterium	400	3 µm	8,000
		6 µm spore	4,000
21 µm		6 µm	11,200
		6 µm	2,400
	800	6 µm	400
Dinoflagellates		9 µm	1,600
		9 µm	5,200
Goniaulax catenata	400	9 µm	400
Gymnodinium lohmanni	1,200	15 µm	12,800
Peridinium brevipes	1,200	18 µm	800
Peridinium pallidum	400	30 µm	400
		45 µm	1,600
Flagellates		140 µm ciliate	400
Calycomonas ovalis	400		
Calycomonas vangoorii	6,000		
Dinobryon balticum	8,800		
D. balticum loricae	131,600		
Monosiga marina	20,800		
Platymonas sp. 6 µm	7,600		
3 µm	5,200		
empty	4,400		
3 µm	22,600		
3 µm	6,000		
6 µm	5,200		
6 µm	3,200		
6 µm	26,000		
9 µm	4,000		
9 µm	800		
15 µm	2,000		

Table 27-B

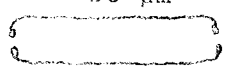
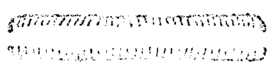
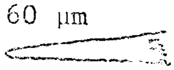
PB 105, 0 m depth, 50 ml, 100 X	
Diatoms	Cells $liter^{-1}$
Navicula directa	20
50 µm 	20
60 µm 	20
Dinoflagellates	
Goniaulax catenata	60
Gymnodinium lohmanni	220
Peridinium brevipes	220
Peridinium minusculum	380
Peridinium pallidum	260
Flagellates	
Ebria tripartita	20
Unknown	
33 µm 	40
60 µm  tintinnid	60

Table 28-A

PB 105, 4.5 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros sp.	400
Cylindrotheca closterium	400
Nitzschia sigmoidea	400
Thalassiosira sp.	400
15 μm	400
24 μm	400
30 μm	1,200
Dinoflagellates	
Gymnodinium lohmanni	400
Peridinium brevipes	400
Peridinium pallidum	400
Unknown	
3 μm	1,600
6 μm	10,400
6 μm spore	3,600
9 μm	1,200
9 μm	1,200
9 μm spore	400
9 μm	800
12 μm	400
15 μm	5,200
18 μm	400
21 μm ciliate	400
24 μm	400
39 μm	400

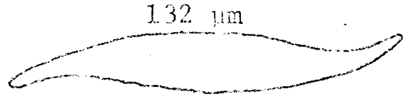
Flagellates	Cells liter^{-1}
Calycomonas vangoorii	21,200
Dinobryon balticum	24,400
D. balticum loricae	134,800
Monosiga marina	19,200
Platymonas sp. 6 μm	40,400
3 μm	6,800
empty	2,000
3 μm	10,400
3 μm	1,200
3 μm	2,400
6 μm	4,400
6 μm	1,200
6 μm	12,400
6 μm	800
6 μm	800
6 μm	9,200
6 μm	12,800
9 μm	400
9 μm	2,400
12 μm	400
15 μm	800
15 μm	800

Table 28-B

PB 105, 4.5 m depth, 50 ml, 100 X

Diatoms	Cells liter^{-1}
Gyro-Pleurosigma sp.	

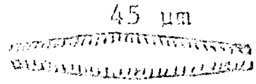
132 µm



20

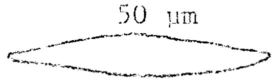
Navicula directa	20
Navicula gelida	20

45 µm



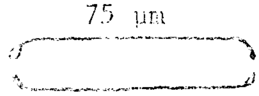
20

50 µm



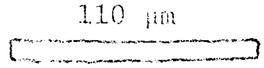
20

75 µm



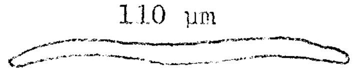
20

110 µm



20

110 µm



20

Dinoflagellates

Dinophysis arctica	40
Peridinium brevipes	present
Peridinium minusculum	280
Peridinium pallidum	320

Table 29-A

PB 106, 0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Cylindrotheca closterium	800
Navicula directa	400
12-15 μm	800
18 μm	400
27 μm	400
33 μm	400
33 μm	400
36 μm	1,200
102 μm	400

Dinoflagellates	
Goniaulax catenata	400
Gymnodinium lohmanni	400
Peridinium belgicum	800
Peridinium minusculum	400

Flagellates	Cells liter^{-1}
Calycomonas ovalis	800
Calycomonas vangoorii	4,400
Calycomonas sp.	400
Dinobryon balticum	29,200
Monosiga marina	10,000
Platymonas sp. 6 μm	20,800
3 μm	3,600
3 μm	24,800
3 μm	5,200
3 μm	400
6 μm	36,800
6 μm	10,200
6 μm	18,400
6 μm	2,400
9 μm	1,600
12 μm	400
15 μm	400

Unknown	
3 μm	9,200
6 μm	12,000
6 μm yellow	6,400
6 μm spore	4,800
6 μm yellow	3,600
9 μm	8,800
12 μm	6,000
12 μm	3,600
15 μm	12,000
18 μm	1,200
60 μm ciliate	800

Table 29-B

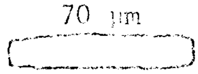
PB 106, 0 m depth, 50 ml, 100 X	
Diatoms	Cells liter^{-1}
Cylindrotheca closterium	20
70 µm 	20
Dinoflagellates	
Peridinium brevipes	60
Peridinium minusculum	140
Peridinium pallidum	60

Table 30-A

PB 107, 5.0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros decipiens	400
Thalassiosira gravida	400
6 µm	400
12 µm	400
12 µm	400
30 µm	400
Dinoflagellates	
Peridinium brevipes	400
Peridinium pallidum	400

Flagellates	Cells liter^{-1}
Dinobryon balticum	10,800
Ebria tripartita	800
Monosiga marina	14,400
Platymonas sp. 5 µm	10,000
3 µm	5,200
3 µm	12,200
3 µm	400
5 µm	17,200
6 µm	28,400
6 µm	1,600
6 µm	1,600
6 µm	3,200
15 µm	800
Unknown	
6 µm	15,600
6 µm spore	1,200
6 µm	1,200
6 µm	800
9 µm	400
15 µm	9,600
15 µm	1,200
30 µm ciliate	400
54 µm	800
75 µm tintinnid	400

Table 30-B

PB 107, 5 m depth, 50 ml, 100 X

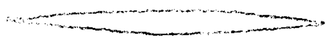
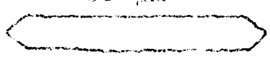
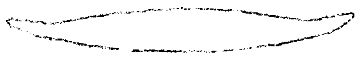
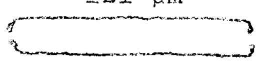
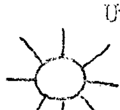
Diatoms	Cells liter^{-1}
Chaetoceros sp.	160
Nitzschiella acicularis	20
Thalassiosira sp.	20
77 µm 	20
88 µm 	40
110 µm 	20
121 µm 	20
Dinoflagellates	
Dinophysis arctica	20
Goniaulax catenata	280
Peridinium brevipes	80
Peridinium minusculum	200
Peridinium pallidum	240
Flagellates	
Ebria tripartita	40
Unknown	
30 µm 	20
50 µm 	120

Table 31-A

PB 108, 3.5 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Thalassiosira sp.	400
15 µm	3,200
Dinoflagellates	
Gymnodinium lohmanni	1,600
Peridinium brevipes	400
Peridinium minusculum	400
Flagellates	
Calycomonas vangoorii	36,800
Dinobryon balticum	37,600
D. balticum loricae	96,400
Monosiga marina	24,800
Platymonas sp. 6 µm	4,400
3 µm	7,200
empty	2,400
3 µm	7,200
3 µm	2,800
6 µm	3,200
6 µm	3,200
6 µm	8,800
9 µm	800
9 µm	800

Unknown	Cells liter^{-1}
3-6 µm	12,000
6 µm spore	3,200
6 µm	400
9 µm spore	2,400
9 µm	2,400
9 µm	800
15 µm	7,200
45 µm	2,800
88 µm ciliate	400

Table 31-B

PB 108, 3.5 m depth, 50 ml, 100 X	
Dinoflagellates	Cells liter^{-1}
Peridinium brevipes	100
Peridinium depressum Bailey	40
Peridinium minusculum	20
Peridinium pallidum	40
Unknown	
44 µm 	20

Table 32-A

PB 109, 0 m depth, 5 ml, 400 X +

Diatoms	Cells liter^{-1}
12 µm	1,200
30 µm	400
Dinoflagellates	
Gymnodinium lohmanni	800
Peridinium belgicum	1,200
Peridinium minusculum	400
Unknown	
3 µm	5,200
3 µm	800
4 µm spore	1,200
6 µm spore	400
6 µm	18,400
6 µm	1,600
6 µm spore	400
9 µm	18,400
9 µm spore	6,000
9 µm	3,600
15 µm ciliate	800
15 µm	2,200
18 µm	400
95 µm ciliate	800

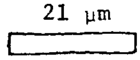
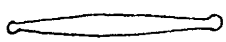
Flagellates	Cells liter^{-1}
Calycomonas vangoorii	16,000
Dinobryon balticum	14,800
Monosiga marina	22,400
Platymonas sp. 6 µm	1,600
3 µm	2,800
3 µm	11,600
3 µm	400
3 µm	400
3 µm	3,600
6 µm	13,600
6 µm	4,000
6 µm	9,200
9 µm	800
15 µm	3,600
15 µm	1,200

Table 32-B

PB 109, 0 m depth, 50 ml, 100 X	
Diatoms	Cells liter^{-1}
Thalassiosira sp. 50 μm	20

Table 33-A

PB 110, 0 m depth, 5 ml, 400 X

Diatoms	Cells $liter^{-1}$
Chaetoceros sp.	400
21 µm 	400
24 µm 	400
36 µm 	400
Dinoflagellates	
Gymnodinium lohmanni	800
Peridinium brevipes	400
Peridinium minusculum	800
24 µm 	800
Unknown	
3-6 µm	16,400
6 µm spore	4,000
6 µm	400
6-9 µm	1,200
9 µm spore	2,400
9 µm	14,400
9 µm	1,200
12 µm	1,200
15 µm	4,000
21 µm	400
24 µm	400

Flagellates	Cells $liter^{-1}$
Calycomonas vangoorii	6,000
Dinobryon balticum	46,000
D. balticum loricae	64,000
Monosiga marina	14,400
Platymonas sp. 6 µm	2,800
3 µm	16,800
3 µm	1,200
3 µm	800
3 µm	6,000
6 µm	400
6 µm	8,400
6 µm	400
6 µm	1,200
6 µm	400
6 µm	6,800
6 µm	24,800
9 µm	1,600
9 µm	1,600
9 µm	1,200
9 µm	400
9 µm	2.000
9 µm	400
15 µm	800

Table 33-B

PB 110, 0 m depth, 50 ml, 100 X

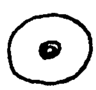
Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	60
Gymnodinium lohmanni	80
Peridinium brevipes	120
Peridinium minusculum	20
Peridinium pallidum	140
Unknown	
30 µm 	60

Table 34-A

PB 110, 4.5 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Cocconeis sp. 15 µm	800
Cylindrotheca closterium	400
Thalassiosira sp.	400
12 µm	1,200

Dinoflagellates	Cells liter^{-1}
Gymnodinium lohmanni	800
Peridinium brevipes	800
Peridinium minusculum	400
21 µm	800

Unknown	Cells liter^{-1}
3-6 µm	18,000
6 µm spore	4,000
6 µm	400
9 µm	17,600
9 µm	1,600
9 µm spore	1,200
12 µm	800
15 µm	14,400
18 µm	800
21 µm	1,600
27 µm	1,200
30 µm	2,700
45 µm	800
59 µm ciliate	400

Flagellates	Cells liter^{-1}
Calycomonas ovalis	4,000
Calycomonas vangoorii	10,000
Dinobryon balticum	15,600
D. balticum loricae	83,600
Euglenoid 27 µm	400
Monosiga marina	24,400
Platymonas sp. 6 µm	22,000
3 µm	4,800
empty	1,600
3 µm	17,600
3 µm	400
3 µm	800
3 µm	6,400
6 µm	2,000
6 µm	6,400
6 µm	14,800
6 µm	8,000
9 µm	1,200
9 µm	800
15 µm	2,000

Table 34-B

PB 110, 4.5 m depth, 50 ml, 100 X

Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	40
Gymnodinium lohmanni	220
Peridinium brevipes	40
Peridinium minusculum	200
Peridinium pallidum	140
Unkeown	
55 µm 	20

Table 35-A

PB 112, 1.0 m depth, 5 ml, 400 X

Diatoms	Cells $liter^{-1}$
Cylindrotheca closterium	400
12 µm	1,200
12 µm	1,200
18 µm	800
18 µm	800
21 µm	400
30 µm	400
39 µm	400

Dinoflagellates	Cells $liter^{-1}$
Peridinium brevipes	400
Peridinium minusculum	400
Peridinium pallidum	400

Flagellates	Cells $liter^{-1}$
Calycomonas ovalis	400
Dinobryon balticum	4,800
Ebria tripartita	1,600
Euglenoid	1,600
Platymonas sp. 6 µm	4,400
3 µm	2,400
3 µm	11,200
3 µm	800
3 µm	4,000
6 µm	23,200
6 µm	16,400
6 µm	2,800
6 µm	400
6 µm	800
9 µm	2,400
9 µm	2,000
9 µm	2,000
21 µm	800

Unknown	Cells $liter^{-1}$
3-6 µm	52,400
6 µm spore	5,200
6 µm	13,600
6 µm yellow	400
9 µm	15,200
9 µm yellow	2,800
9 µm spore	400
12 µm ciliate	400
12 µm ciliate	1,600
15 µm	800
30 µm	800

Table 35-B

PB 112, 1.0 m depth, 50 ml, 100 X

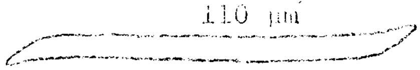
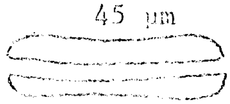
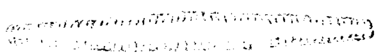
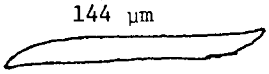
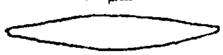
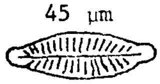
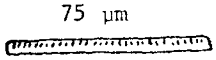
Diatoms	Cells $liter^{-1}$
Gyro-Pleurosigma sp.	
110 µm 	20
45 µm 	20
110 µm 	40

Table 36-A

PB 113, 1.0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Amphora sp. 18 µm 	400
Gyro-Pleurosigma sp. 144 µm 	400
18 µm 	800
24 µm 	400
45 µm 	400
75 µm 	400

Dinoflagellates	
Peridinium pallidum	400

Cyanophytes	
Merismopedia sp.	16,800

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	1,200
Dinobryon balticum	6,400
Ebria tripartita	4,000
Euglenoid	4,000
Monosiga marina	800
Platymonas sp. 6 µm	3,600
3 µm	5,600
3 µm	2,000
6 µm	5,600
6 µm	8,800
9 µm	2,400
9 µm	6,000
15 µm	2,000
15 µm	2,800
18 µm	800

Unknown	
3-6 µm	436,000
6 µm spore	6,400
6 µm spore	800
9 µm	8,000
9 µm yellow	3,600
9 µm spore	400
12 µm	34,000
12 µm spore	400
15 µm	12,000
15 µm yellow	2,000
30 µm	1,600
30 µm	400

Table 36-B

PB 113, 1.0 m depth, 50 ml, 100 X

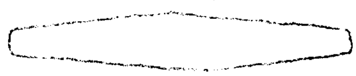
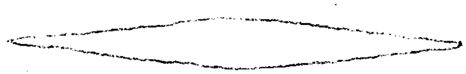
Diatoms	Cells $liter^{-1}$
Gyrosigma faciola	40
110 µm 	20
165 µm 	40

Table 37-A

PB 114, 1.0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Thalassiosira nordenskiöldii	400
9 µm	800
15 µm	800
18 µm	400
18 µm	400
39 µm	400
39 µm	400
126 µm	400

Dinoflagellates	
Gymnodinium lohmanni	1,200
Peridinium minusculum	800

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	1,600
Diaphanoeca grandis	400
Dinobryon balticum	12,400
Ebria tripartita	400
Euglenoid	2,000
Monosiga marina	1,200
Platymonas sp. 6 µm	6,400
3 µm	400
3 µm	800
3 µm	8,400
3 µm	1,200
3 µm	400
6 µm	25,200
6 µm	14,000
6 µm	3,200
6 µm yellow	1,200
6 µm	800
9 µm	2,400
15 µm	800

Unknown	
3-6 µm	49,200
5 µm spore	2,000
6 µm	800
9 µm	10,800
9 µm	19,600
9 µm	800
9 µm spore	1,200
12 µm spore	9,200
12 µm yellow	6,400
15 µm	11,200
25 µm	1,200

Table 37-B

PB 114, 1.0 m depth, 50 ml, 100 X	
Diatoms	Cells liter^{-1}
Fragilariopsis spp.	present
Dinoflagellates	
Peridinium minusculum	present

Much sediment

Table 38-A

PB 117, 2 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Cylindrotheca closterium	400
12 µm	2,800
12 µm	400
15 µm	1,200
15 µm	400
39 µm	800
39 µm	400
Dinoflagellates	
Peridinium minusculum	1,200
Peridinium pallidum	800
Unknown	
3-6 µm	14,000
6 µm	2,000
9 µm spore	400
12 µm spore	800
15 µm	400
15 µm	3,600
30 µm	2,400

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	16,800
Dinobryon balticum	10,800
D. balticum loricae	92,800
Euglenoid	1,200
Monosiga marina	39,600
Platymonas sp. 6 µm	58,400
3 µm	5,600
empty	2,400
3 µm	20,000
3 µm	8,000
3 µm	400
6 µm	10,800
6 µm	1,600
6 µm	800
6 µm	3,200
6 µm	400
9 µm	1,600
9 µm	1,200
12 µm	1,600

Table 38-B

PB 117, 2 m depth, 50 ml, 100 X

Diatoms	Cells liter^{-1}
Nitzschia frigida	60
Thalassiosira sp.	20
Dinoflagellates	
Dinophysis artica	20
Peridinium brevipes	120
Peridinium minusculum	80
Peridinium pallidium	120
Unknown	
50 µm 	20

Table 39-A

PB 118, 0 m depth, 5 mL, 400 X

Diatoms	Cells liter^{-1}
Fragilariopsis sp.	2,800
9 µm	400
15 µm	3,600
36 µm	400
39 µm	400
Dinoflagellates	
Peridinium trochoideum	800
Unknown	
3-6 µm	8,400
6 µm spore	1,600
6 µm	13,600
9 µm spore	31,600
9 µm spore	2,400
9 µm	800
9 µm spore	1,200
12-15 µm	2,800
15 µm	400
18 µm	1,600
36 µm	1,200

Flagellates	Cells liter^{-1}
Calycomonas ovalis	400
Calycomonas vangoorii	27,200
Dinobryon balticum	15,600
D. balticum loricae	140,800
Monosiga marina	24,000
Platymonas sp. 6 µm	28,800
3 µm	8,000
empty	5,200
3 µm	27,200
3 µm	7,600
3 µm	11,200
6 µm	26,800
6 µm	3,600
6 µm	10,800
6 µm	400
6 µm	20,400
6 µm	2,000
6 µm	34,000
6 µm	800
9 µm	1,600
15 µm	1,200
15 µm	400
15 µm	400

Table 39-B

PB 118, 0 m depth, 50 ml, 100 X

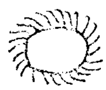
Dinoflagellates	Cells liter^{-1}
Peridinium brevipes	40
Peridinium minusculum	400
Peridinium pallidum	100
Unknown	
45 µm  tintinnid	20
55 µm  tintinnid	100

Table 40-A

PB 118, 5.5 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
12 µm	800
15 µm	400
15 µm	800
15 µm	400
18 µm	800
66 µm	400
150 µm	400

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	6,400
Dinobryon balticum	12,400
Monosiga marina	16,800
Platymonas sp. 6 µm	202,400
3 µm	3,200
3 µm	23,200
6 µm	22,800
6 µm	21,200
6 µm	5,200
15 µm	800
15 µm	5,600
15 µm	400
21 µm	400

Dinoflagellates	Cells liter^{-1}
Peridinium brevipes	400
Peridinium minusculum	1,200

Unknown	Cells liter^{-1}
3-6 µm	39,200
6 µm yellow	8,400
6 µm spore	400
9 µm spore	3,200
15 µm	13,200
15 µm	3,600
15 µm	2,000
21 µm ciliate	400

Table 40-B

PB 118,	5.5 m depth,	50 ml,	100 X

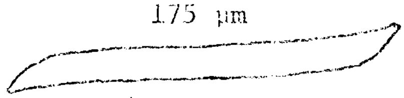
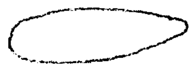
	Diatoms	Cells liter^{-1}
Gyro-Pleurosigma sp.	175 µm 	20
	Dinoflagellates	
Peridinium brevipes		20
Peridinium minusculum		20
Peridinium pallidum		200
	Flagellates	
Euglenoid	77 µm 	20

Table 41-A

PB 119, 5.0 m depth, 5 ml, 400 X

Diatoms	Cells $liter^{-1}$
Chaetoceros decipiens	1,200
12 μm	800
15 μm	1,200
30-33 μm	800
36 μm	1,200

Dinoflagellates	
Peridinium minusculum	1,200
Peridinium pallidum	400

Unknown	
3-6 μm	26,800
6 μm spore	400
9 μm spore	1,200
12 μm	4,400
12 μm	1,200
15 μm	2,000
15 μm	3,600
15 μm	800
21 μm	800
30 μm	800
36-72 μm tintinnids	800

Flagellates	Cells $liter^{-1}$
Calycomonas vangoorii	14,400
Dinobryon balticum	16,000
D. balticum loricae	92,800
Euglenoid 45 μm	1,200
Monosiga marina	31,600
Platymonas sp. 6 μm	133,200
3 μm	4,000
empty	2,800
3 μm	15,600
3 μm	3,200
6 μm	24,800
6 μm	10,400
6 μm	14,400
6 μm	1,200
6 μm	400
9 μm	1,600
9 μm	400
12 μm	3,200
15 μm	400

Table 41-B

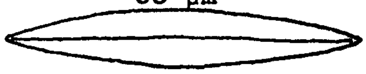
PB 119, 5.0 m depth, 50 ml, 100 X	
Diatoms	**Cells liter^{-1}**
Chaetoceros decipiens	40
Cylindrotheca closterium	20
88 µm 	40
Dinoflagellates	
Goniaulax catenata	80
Peridinium brevipes	280
Peridinium minusculum	280
Peridinium pallidum	360

Table 42

PB 120, 0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
12 µm	400
18 µm	400
Dinoflagellates	
Gymnodinium lohmanni	800
Unknown	
3-6 µm	13,200
6 µm spore	4,400
9 µm	2,400
9 µm	400
15 µm	2,000
15 µm	4,800
18 µm	1,600
21 µm	400
39 µm ciliate	800
45 µm	400

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	8,800
Dinobryon balticum	10,400
D. balticum loricae	73,200
Monosiga marina	62,000
Platymonas sp. 6 µm	4,000
3 µm	2,800
empty	1,600
3 µm	6,400
3 µm	400
6 µm	9,200
6 µm	3,600
6 µm	3,200
9 µm	400
9 µm	800
9 µm	400

Table 43-A

PB 120, 8.0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros atlanticus	6,400
Chaetoceros decipiens	16,000
Chaetoceros septentrionalis	1,600
Chaetoceros socialis	1,200
Chaetoceros subsecundus	1,600
Chaetoceros sp.	16,400
Cylindrotheca closterium	1,600
Navicula directa	400
Thalassiosira gravida	2,400
Thalassiosira nordenskiöldii	1,200
9 μm	800
12 μm	400
15 μm	400
15 μm	800
30 μm	400

Dinoflagellates	
Goniaulax catenata	400
Gymnodinium lohmanni	2,000
Peridinium minusculum	400
Peridinium trochoideum	800

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	1,200
Dinbryon balticum loricae	400
Ebria tripartita	400
Euglenoid 27 μm	400
Monosiga marina	11,200
Platymonas sp. 6 μm	93,200
3 μm	2,000
3 μm	6,800
3 μm	13,200
3 μm	2,400
6 μm	4,800
6 μm	800
6 μm	6,800
9 μm	400
9 μm	3,200
9 μm	800
9 μm	3,200
15 μm	1,200

Unknown	
3-6 μm	11,200
6 μm	13,200
6 μm	1,200
6 μm spore	800
9 μm	12,400
9 μm	400
9 μm ciliate	1,200
12-15 μm	3,200
15 μm	400
30 μm ciliate	400

Table 43-A (continued)

Unknowns (continued)

9 µm 	400
9 µm 	1,200
12–15 µm 	3,200
15 µm 	400
30 µm  ciliate	400

Table 43-B

PB 120, 8.0 m depth. 50 ml, 100 X

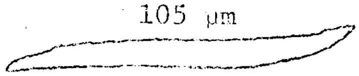
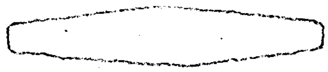
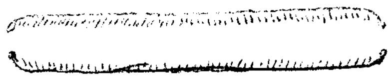
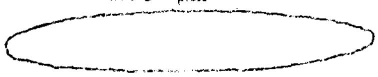
Diatoms	Cells liter^{-1}
Chaetoceros atlanticus	2,380
Chaetoceros decipiens	2,640
Cylindrotheca closterium	20
Gyro-Pleurosigma sp.	
105 µm 	20
Nitzschiella acicularis	260
Thalassiosira gravida	40
Thalassiosira sp.	120
99 µm 	100
121 µm 	40
165 µm 	20
Dinoflagellates	
Gymnodinium lohmanni	180
Peridinium brevipes	40
Peridinium minusculum	60
Peridinium pallidum	60

Table 44 A

PB 121, 0 m depth, 5 ml, 400 X

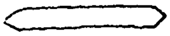
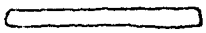
Diatoms	Cells liter^{-1}	Unknown	Cells liter^{-1}
Cylindrotheca closterium	400	3 µm	9,600
		6 µm	18,800
24 µm 	400	6 µm spore	800
		6 µm	12,400
		6 µm spore	2,800
39 µm 	400	12 µm	6,800
		15 µm	13,600
		18 µm	1,600
39 µm 	400		
60 µm 	1,600	45 µm 	2,400
Dinoflagellates			
Peridinium brevipes	800		
Flagellates			
Calycomonas vangoorii	29,200		
Dinobryon balticum	20,800		
Monosiga marina	76,400		
Platymonas sp. 6 µm	2,400		
3 µm	8,400		
3 µm	24,000		
6 µm	13,600		
6 µm	18,400		
6 µm	1,200		
16 µm	1,200		

Table 44-B

PB 121, 0 m depth, 50 ml, 100 X	
Dinoflagellates	Cells liter^{-1}
Gymnodinium lohmanni	160
Peridinium brevipes	60
Peridinium minusculum	420
Peridinium pallidum	80

Table 45-A

PB 121, 7.0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}	Unknown		Cells liter^{-1}
Chaetoceros decipiens	8,400	3 µm		10,000
Chaetoceros socialis	1,600	6 µm		10,400
Chaetoceros sp.	800	6 µm		4,400
Cylindrotheca closterium	800	6 µm	yellow	400
		6 µm	spore	400
15 µm		9 µm		1,600
		9 µm	spore	400
	400	15 µm		4,400
		18 µm		1,200
30 µm		30 µm		400
	400			

Flagellates

Dinobryon balticum	1,200
D. balticum loricae	10,000
Monosiga marina	4,800
Platymonas sp. 6 µm	90,400
3 µm	3,600
empty	1,600
3 µm	20,800
3 µm	2,000
6 µm	13,600
6 µm	6,400
6 µm	12,800
6 µm	400
9 µm	2,000
9 µm	3,600
9 µm	400

Table 45-B

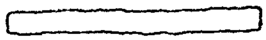
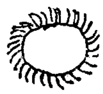
PB 121, 7.0 m depth, 50 ml, 100 X	
Diatoms	Cells $liter^{-1}$
Cylindrotheca closterium	20
60 µm 	20
60 µm 	20
Dinoflagellates	
Peridinium brevipes	100
Peridinium depressum	20
Peridinium minusculum	100
Peridinium pallidum	60
Unknown	
45 µm  ciliate	20

Table 46-A

PB 122, 4.0 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros decipiens	1,600
Chaetoceros sp.	400
12 µm	400
12 µm	400
18 µm	400
24 µm	400
30 µm	400
Dinoflagellates	
Peridinium brevipes	400
Peridinium minusculum	400
15 µm	400

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	23,200
Dinema litorale Skuja	400
Dinobryon balticum	63,600
D. balticum loricae	134,400
Euglenoid 24 µm	400
Monosiga marina	54,400
Platymonas sp. 6 µm	118,400
3 µm	6,400
empty	8,000
3 µm	21,200
3 µm	6,000
6 µm	7,200
6 µm	16,800
6 µm	3,200
6 µm	6,400
6 µm	10,800
9 µm	3,600
9 µm	400
9 µm	400
9 µm	1,600
12 µm	1,600
12 µm	5,200
Unknown	
3-6 µm	7,600
6 µm	4,800
6 µm spore	400
6 µm spore	1,200
9 µm	2,800
18 µm	800
21 µm	2,000
30 µm	2,000
57 µm	400

Table 46-B

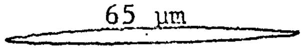
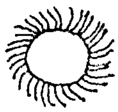
PB 122, 4.0 m depth, 50 ml, 400 X	
Diatoms	Cells liter^{-1}
65 µm 	20
Dinoflagellates	
Peridinium brevipes	60
Peridinium minusculum	280
Peridinium pallidum	420
Unknown	
50 µm  tintinnid	20

Table 47-A

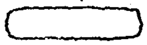
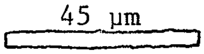
PB 123, 4,5 m depth, 5 ml, 400 X

Diatoms	Cells liter^{-1}
Chaetoceros decipiens	400
16 µm	800
36 µm	400
54 µm	400
Dinoflagellates	
Peridinium belgicum	800
Peridinium brevipes	800
Peridinium minusculum	400
Unknown	
3 µm	11,200
3 µm spore	400
6 µm	400
6 µm yellow	1,200
6 µm	800
6 µm	400
6 µm spore	400
9 µm	5,200
9 µm	400
12-15 µm spore	2,400
15-18 µm	23,600
30 µm	400
90 µm	2,800

Flagellates	Cells liter^{-1}
Calycomonas ovalis	2,400
Calycomonas vangoorii	22,800
Dinobryon balticum	19,200
Monosiga marina	106,400
Platymonas sp. 6 µm	36,800
3 µm	4,800
3 µm	16,000
3 µm	4,400
4 µm	5,600
6 µm	31,200
6 µm	800
6 µm	6,400
6 µm	6,000
9 µm	2,800
9 µm	800
9 µm	800
15 µm	3,200
15 µm	2,000
15 µm	400

Table 47-B

PB 123, 4.5 m depth, 50 ml, 100 X

Diatoms	Cells liter^{-1}
Chaetoceros sp.	20
33 µm 	20
45 µm 	20
66 µm 	40
Dinoflagellates	
Gymnodinium lohmanni	200
Peridinium brevipes	80
Peridinium minusculum	100
Peridinium pallidum	80

Spring Sampling, 1972

Table 48

Prudhoe Bay, 25-V-72, Bottom Ice, 5 ml, 500 X

Diatoms

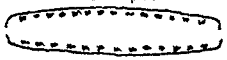
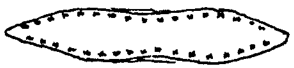
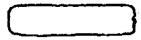
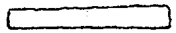
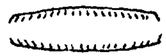
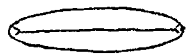
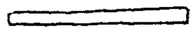
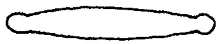
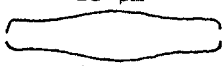
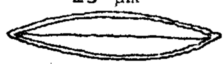
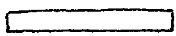
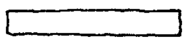
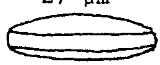
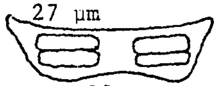
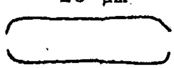
	Cells counted	Cells liter^{-1}
Chaetoceros septentrionalis	3	38,400
Cylindrotheca closterium	2	25,600
Diploneis sp.	12	153,700
Fragilariopsis spp.	14	179,400
Navicula debilissima	8	102,500
Navicula gelida	1	12,800
Navicula kryokonites	1	12,800
Navicula transitans	14	179,400
Navicula sp.		
36 μm; 18 μm 	1	12,800
Nitzschia frigida	71	909,700
Nitzschia spp.		
36 μm; 9 μm 	1	12,800
89 μm; 16 μm 	1	12,800
Unidentified Diatoms		
9 μm; 5 μm 	1	12,800
10 μm; 3 μm 	7	89,700
14 μm; 3 μm 	13	166,600
16 μm; 2 μm 	1	12,800
16 μm; 5 μm 	3	38,400
18 μm; 3 μm 	8	102,500
18 μm; 5 μm 	3	38,400
18 μm; 9 μm 	1	12,800
18 μm; 3 μm 	4	51,200
21 μm; 2 μm 	15	192,200

Table 48 (continued)

Width	Length		Cells counted
3 µm	21 µm		4
5 µm	21 µm		1
5 µm	23 µm		1
10 µm	23 µm		1
2 µm	25 µm		2
3 µm	27 µm		2
7 µm	27 µm		1
	27 µm		8
9 µm	28 µm		3

Diatoms (continued)

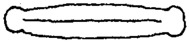
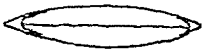
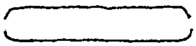
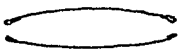
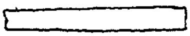
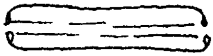
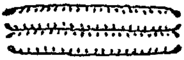
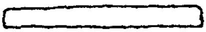
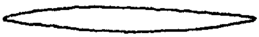
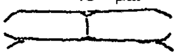
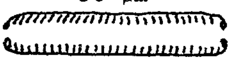
Cells liter^{-1}				Cells counted	Cells liter^{-1}
51,200	5 μm	28 μm		2	25,600
12,800	5-9 μm	28 μm		6	76,800
12,800	5 μm	28 μm		7	89,700
12,800	10 μm	32 μm		6	76,900
25,600	5 μm	32 μm		5	64,100
25,600	14 μm	32 μm		1	12,800
12,800	7 μm	36 μm		8	102,500
102,500	3 μm	36 μm		5	64,100
38,400	9 μm	39 μm		2	25,600

Table 48 (continued)

Width	Length	Cell	Cells counted
7 µm	39 µm		1
9 µm	40 µm		4
3 µm	42 µm		3
3 µm	45 µm		3
5 µm	45 µm		20
10 µm	45 µm		1
9 µm	48 µm		1
7 µm	50 µm		17
7 µm	53 µm		2

Diatoms (continued)

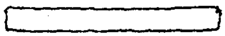
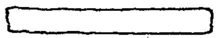
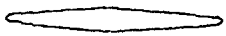
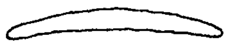
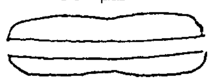
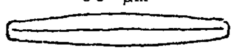
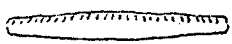
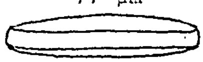
Cells liter^{-1}				Cells counted	Cells liter^{-1}
12,800	3 µm	58 µm		2	25,600
51,200	5 µm	59 µm		1	12,800
38,400	5 µm	59 µm		1	12,800
38,400	3 µm	59 µm		1	12,800
256,200	14-15 µm	60 µm		2	25,600
12,800	7 µm	60 µm		13	166,600
12,800	5 µm	75 µm		1	12,800
217,800	7 µm	77 µm		5	64,100
25,600		88 µm		14	179,400

Table 48 (continued)

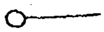
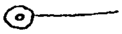
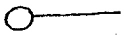
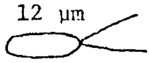
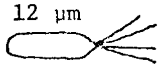
	Cells counted	Cells liter^{-1}
Dinoflagellates		
Peridinium pallidum	1	12,800
Cryptophytes		
9 µm 	1	12,800
Unidentified Flagellates		
2 µm 	1	12,800
5 µm 	2	25,600
5 µm 	1	12,800
7 µm 	1	12,800
11 µm 	1	12,800
5 µm, 12 µm 	1	12,800
5 µm, 12 µm 	3	38,400
14 µm 	2	25,600
Unknowns		
9 µm 	1	12,800
10 µm 	1	12,800
16 µm 	4	51,200
28 µm 	1	12,800

Table 49-A

Prudhoe Bay 25-V-72 Water Sample 5 ml 400 X

Diatoms	Cells liter^{-1}
Chaetoceros sp.	800
Fragilariopsos sp.	27,600
Navicula debilissima	8,000
Navicula directa	1,200
Navicula pelagica Cleve	11,200
Nitzschia frigida	12,000
Thalassiosira sp.	400
4 µm 18 µm	5,600
21 µm	400
30 µm	2,000
45 µm	800
51 µm	1,200
63 µm	800
66 µm	400
90 µm	400
Dinoflagellates	
Glenodinium sp. 15 µm	1,200
27 µm	2,800
Goniaulax catenata	1,600
Peridinium pallidum	800
Unknown	
6 µm	2,000
6 µm	1,200
9 µm	800
12 µm	8,000
15 µm	400

Silicoflagellates	Cells liter^{-1}
Ebria tripartita	400
Chrysophytes	
6 µm	7,600
6 µm	400
Cryptophytes	
6 µm	800
12 µm	800
12 µm	6,000
Prasinophytes	
9 µm	4,400
9 µm	1,600
9 µm	1,200
Unknown Flagellates	
3 µm	1,600
3 µm	400
3-6 µm	1,200
6 µm	400
6 µm	1,200
6 µm	400
6 µm	2,000
6 µm	400
9 µm	8,800
9 µm	1,200
9 µm	2,000
9 µm	800
12 µm	400
12 µm	400
15 µm	1,600
18 µm	800
18 µm	800
21 µm	800
24 µm	400

Table 49-B

Prudhoe Bay, 25-V-73, Water Sample, 50 ml, 100 X

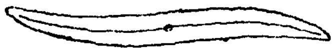
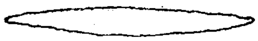
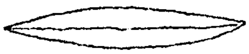
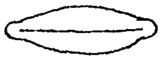
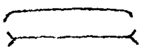
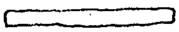
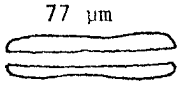
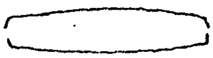
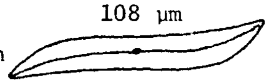
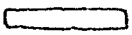
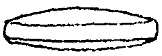
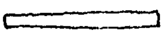
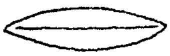
Diatoms	Cells liter^{-1}	Flagellates	Cells liter^{-1}
Gyro-Pleurosigma sp. 110 µm 	20	*Goniaulax catenata*	80
		Peridinium brevipes	80
		Peridinium pallidum	420
		Peridinium sp.	20
Nitzschia frigida	15,820		
Navicula transitans	440		
		Unknown	
40 µm 	680	*Ebria tripartita*	40
40 µm 	120		
44 µm 	20		
44 µm 	20		
50 µm 	380		
60 µm 	280		
77 µm 	20		
110 µm 	20		

Table 50

Reindeer Island, Bottom Ice, 25-V-72, 5 ml, 500 X

Diatoms

Taxon	Width	Length	Drawing	Cells liter^{-1}
Chaetoceros septentrionalis				400
Diploneis sp.				800
Fragilariopsis spp.				8,400
Gomphonema exiguum				800
Gyro-Pleurosigma sp.	20 µm	108 µm		6,000
Navicula directa				11,200
Navicula gelida				2,400
Navicula sibirica				400
Navicula transitans				1,200
Nitzschia sp.		75-100 µm		3,600
		9 µm		5,600
	3 µm	17 µm		6,000
	3 µm	17 µm		12,000
	5 µm	20 µm		3,200
		25 µm		2,400
		25 µm		15,200
		25 µm		800
	10 µm	25 µm		400

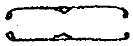
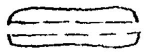
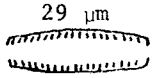
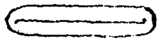
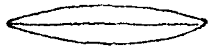
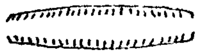
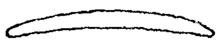
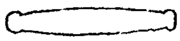
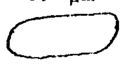
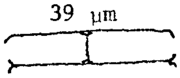
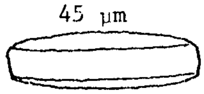
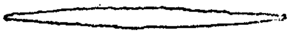
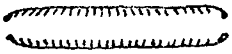
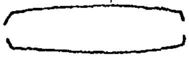
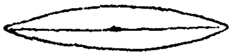
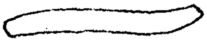
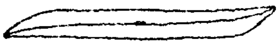
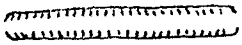
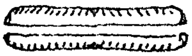
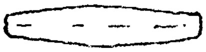
Width	Length	Drawing	Cells liter^{-1}
	27 µm		10,000
9 µm	27 µm		1,600
9 µm	27 µm		1,600
9 µm	29 µm		400
	29 µm		5,200
3-9 µm	29-35 µm		3,200
3 µm	32 µm		2,000
	36 µm		4,400
	36 µm		1,200
	36 µm		400
	39 µm		5,600
9 µm	39 µm		400
	44 µm		5,600
10 µm	45 µm		400

Table 50 (continued)

Diatoms			Cells $liter^{-1}$
	45 μm		4,000
	50 μm		400
	64 μm		400
10 μm	65 μm		800
	66 μm		6,000
17 μm	71 μm		2,000
9 μm	71 μm		400
12 μm	80 μm		1,200
9 μm	84 μm		800
5 μm	89 μm		800
12 μm	116 μm		800
	160 μm		2,000
	307 μm		800

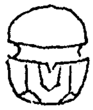
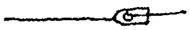
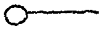
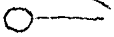
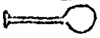
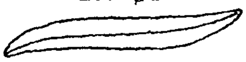
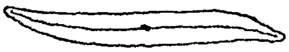
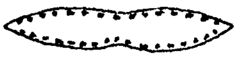
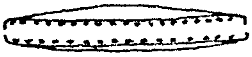
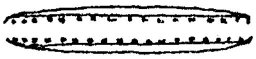
Dinoflagellates			Cells $liter^{-1}$
28 μm			5,200
12 μm	36 μm		800
45 μm	35 μm		400
Flagellates			
3 μm			800
10 μm			400
12 μm			22,000
12 μm			400
17 μm			400
18 μm			1,200
Unknown			
5 μm			2,400
9 μm			5,200
	10 μm		400
12 μm			60,800

Table 51

Reindeer Island, 25-V-72, Water Sample, 5 ml, 500 X

Diatoms

	Cells $liter^{-1}$
Amphiprora spp.	
27–39 μm 	2,000
80 μm, 20 μm 	2,400
Chaetoceros septentrionalis	800
Cylindrotheca closterium	31,600
Fragilariopsis spp.	7,600
Gyro-Pleurosigma spp.	
107 μm, 18 μm 	1,600
158 μm 	400
Navicula debilissima	3,600
Navicula directa	9,600
Navicula gelida	1,200
Navicula pediculus	400
Navicula sibirica	4,800
Navicula transitans	8,400
Nitzschia sigmoidea	400
Nitzschia spp.	
71 μm, 12 μm 	400
89 μm 	400
155 μm, 12 μm 	400
Nitzschiella acicularis	800
Pinnularia quadratarea	400

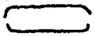
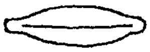
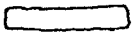
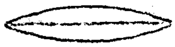
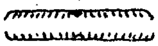
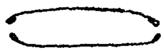
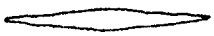
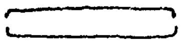
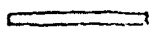
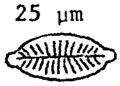
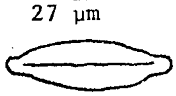
	Cells $liter^{-1}$
9 μm 	3,200
12 μm 	2,400
16 μm, 2 μm 	6,000
16 μm, 9 μm 	400
18 μm 	800
21 μm 	2,400
21 μm 	4,000
21 μm, 10 μm 	400
21–22 μm, 2 μm 	14,400
25 μm, 7 μm 	10,800
25 μm, 2 μm 	4,400
25 μm, 10 μm 	400
25 μm 	1,200
27 μm 	3,200

Table 51 (continued)

Diatoms

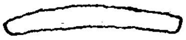
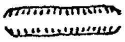
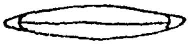
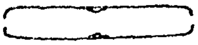
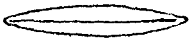
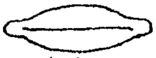
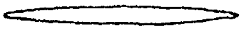
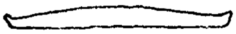
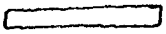
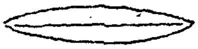
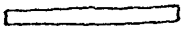
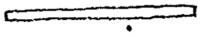
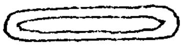
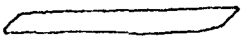
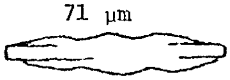
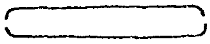
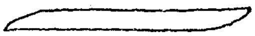
Length	Width	Drawing	Cells $liter^{-1}$
27 µm			1,600
27 µm			2,400
27 µm			1,600
30 µm			6,400
32 µm			3,200
34 µm			24,800
34 µm			9,200
35–39 µm	5 µm		4,000
36 µm	7 µm		2,000
36–60 µm	4 µm		10,000
36 µm			4,000
37 µm	11 µm		400
39 µm	4 µm		3,200
45 µm	11 µm		400
45 µm	12 µm		2,400
45 µm	4 µm		5,200
50 µm	9 µm		1,600
50 µm	2 µm		400
53 µm	3 µm		800
53 µm	2 µm		4,000
60 µm	7 µm		800
62 µm	9 µm		400
68–106 µm	9 µm		3,200
71 µm	10 µm		400
71 µm			400
74 µm			2,400
84 µm	5 µm		400
93 µm			800

Table 51 (continued)

Diatoms	Cells liter^{-1}
94 μm	7,200
107 μm	6,400
116 μm; 7 μm	800
116-198 μm; 5 μm	1,600
116 μm; 5 μm	800
132 μm; 5 μm	800
178 μm	400

Dinoflagellates	Cells liter^{-1}
Peridinium brevipes	400
Peridinium trochoideum	2,000
10-21 μm	3,200
14 μm	5,200
14 μm	400
23 μm	10,000

Cryptophytes	Cells liter^{-1}
7 μm	13,600
12 μm	6,800
14 μm	1,600

Euglenoids	Cells liter^{-1}
20 μm	800
21 μm	800
22 μm	400
71 μm	400

Prasinophytes	Cells liter^{-1}
Platymonas sp. 5 μm	20,000
5 μm	3,200
5-10 μm	13,200
16 μm	5,200
16 μm	5,600
17 μm	15,600

Table 51 (continued)

Unidentified Flagellates	Cells liter^{-1}	Unknown	Cells liter^{-1}
3 μm	800	5 μm	40,800
empty	1,600	10 μm	12,800
2 μm	4,800	14 μm	2,800
2 μm	2,000	14-18 μm	13,600
3 μm	5,600	14 μm spore	400
3 μm	1,600	16 μm ciliate	1,200
3 μm	3,600	18 μm ciliate	400
5 μm	2,400	18 μm	400
5 μm	2,400	26 μm	2,000
7 μm	3,600	27 μm	400
7-9 μm	4,400	28 μm	400
9 μm	2,000	31 μm	400
9 μm	400	51 μm ciliate	1,600
9 μm	1,200		
10 μm	2,000		
10 μm	2,000		
10 μm	4,400		
11 μm	1,600		
12 μm	400		
14 μm	800		
14 μm	2,800		
14-17 μm	1,600		
14 μm	2,800		
14 μm	400		
16 μm	2,000		
16 μm	400		
21 μm	2,000		
22 μm	1,200		
24 μm	400		
28 μm	800		

Cruise III

11 - 15 August 1972

Table 52-A

PB 203, 1.5 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros socialis	3,000
Chaetoceros sp.	600
Cylindrotheca closterium	6,000
Gyro-Pleurosigma sp. 80 µm, 5 µm	600
Nitzschia delicatissima	11,400
Thalassiosira nordenskiöldii	1,200
9 µm	1,800
10 µm, 3 µm	600
10 µm, 3 µm	1,200
12 µm, 3 µm	600
14 µm, 2 µm	1,200
16 µm, 10 µm	3,000
16 µm, 2 µm	1,200
18 µm, 5 µm	600
27 µm, 2 µm	1,800
28 µm, 3 µm	600
30 µm, 3 µm	600
39 µm, 12 µm	1,200
39 µm, 9 µm	1,800

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	600
Dinobryon balticum	22,800
D. balticum loricae	23,400
Euglenoid 18 µm	600
Platymonas sp. 6 µm	93,000
3 µm	3,000
empty	1,800
5 µm	11,400
5 µm	10,800
5 µm	1,200
7 µm	1,200
9 µm	1,200
Unknown	
5 µm	13,800
5 µm spore	2,400
9 µm	1,800
9 µm spore	11,400
10 µm	600
16 µm	2,400
9 µm, 24 µm	1,200
36 µm	1,200
Dinoflagellates	
Peridinium belgicum	1,800

Table 52-B

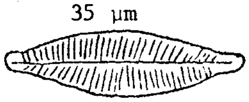
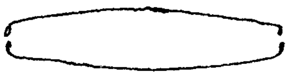
PB 203,	1.5 m depth,	25 ml,	125 X
Diatoms	Cells liter^{-1}	Flagellates	Cells liter^{-1}
35 µm 9 µm 	640	*Ebria tripartita*	320
55 µm 9 µm 	40		

Table 53-A

PB 205b, 1.5 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Cylindrotheca closterium	2,400
Nitzschia delicatissima	4,800
12 µm; 3 µm	600
14 µm; 5 µm	1,200
17 µm; 5 µm	600
19 µm; 11 µm spore	1,200
27 µm; 7 µm	600
Dinoflagellates	
Peridinium pallidum	600

Flagellates	Cells liter^{-1}
Dinobryon balticum	9,000
D. balticum loricae	72,600
Ebria tripartita	2,400
Platymonas 6 µm	196,200
3 µm	3,000
empty	2,400
5 µm	22,200
5 µm	15,000
5 µm	1,800
9 µm	600
9 µm	3,600
Unknown	
5 µm	16,800
9 µm	3,000
9 µm spore	2,400
14 µm	600
89 µm; 89 µm tintinnid	600

Table 53-B

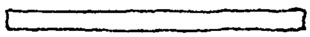
PB 205b,	1.5 m depth,	25 ml,	125 X
	Diatoms	Cells $liter^{-1}$	
	154 µm		
4 µm		40	
	Dinoflagellates		
Peridinium pallidum		640	
	Flagellates		
Ebria tripartita		400	

Table 54-A

PB 206, 2 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros socialis	400
Cylindrotheca closterium	1,200
Nitzschia delicatissima	1,200
17 µm	400
3 µm, 17 µm	400
2 µm, 21 µm	1,600
4 µm, 24 µm	400

Unknown	Cells liter^{-1}
5 µm	4,000
5 µm	10,400
9 µm	6,800
9 µm spore	2,000
20 µm, 35 µm	400

Flagellates	Cells liter^{-1}
Dinobryon balticum	44,400
D. balticum loricae	63,200
Dinobryon sociale Skuja	2,000
Ebria tripartita	5,200
Platymonas sp. 6 µm	188,000
3 µm	2,000
empty	800
4 µm	32,400
5 µm	26,400
5 µm	2,800
9 µm	2,000
9 µm	2,000
9 µm	9,200
21 µm	400

Cyanophytes	Cells liter^{-1}
Merismopedia sp.	1,600

Table 54-B

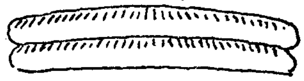
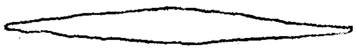
PB 206, 2 m depth, 25 ml, 125 X	
Diatoms	Cells liter^{-1}
Navicula recurvata Gran	
65 µm	
4 µm 	120
71 µm	
	120
Dinoflagellates	
Goniaulax catentata	40
Peridinium pallidum	280
Flagellates	
Ebria tripartita	480

Table 55-A

PB 208, 1.5 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros compressus	400
Chaetoceros septentrionalis	1,600
Chaetoceros socialis	800
Cylindrotheca closterium	2,400
Eucampia zoodiacus	400
Nitzschia delicatissima	4,400
Thalassiosira nordenskiöldii	1,600
7 µm	7,200
10 µm, 2 µm	1,200
12 µm, 4 µm	400
14 µm, 2 µm	400
14 µm, 5 µm	800
14 µm	2,000

Dinoflagellates

Goniaulax catenata	400
Peridinium minusculum	400

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	2,800
Dinema litorale Skuja	400
Dinobryon balticum	119,200
D. balticum loricae	90,000
Ebria tripartita	2,400
Euglenoid 21 µm	400
Platymonas sp. 6 µm	219,600
3 µm	800
3 µm	19,400
3 µm	26,400
5 µm	8,400
9 µm	1,600
12 µm	1,600
17 µm	2,800

Unknown

5 µm	10,000
7 µm spore	400
12 µm	800
18 µm	1,200
40 µm tintinnid	400

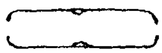
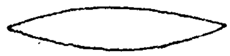
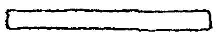
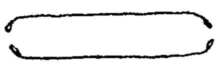
Table 55-B

PB 208, 1.5 m depth, 25 ml, 125 X

Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	20
Peridinium brevipes	80
Peridinium pallidum	240
Flagellates	
Ebria tripartita	100
Unknown	
43 µm 	40

Table 56-A

PB 209, 1.5 m, 5 ml, 500 X

Diatoms		Cells liter^{-1}
Chaetoceros compressus		400
Chaetoceros septentrionalis		400
Chaetoceros socialis		1,200
Cylindrotheca closterium		1,600
Nitzschia delicatissima		6,400
Thalassiosira nordenskiöldii		2,000
	9 m 	9,200
	9 m  spore	2,000
7 µm	11 µm 	400
2 µm	18 µm 	400
4 µm	20 µm 	400
9 µm	36 µm 	400

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	800
Dinobryon balticum	124,400
D. balticum loricae	96,200
Ebria tripartita	1,600
Platymonas sp. 6 µm	71,200
3 · m	2,800
empty	800
3 µm	1,200
3 µm	14,400
3 µm	15,600
5 µm	1,600
9 µm	800
9 µm	2,000
12 µm	400
Unknown	
5 µm	8,800
7 µm spore	400
9 µm	3,600
23 µm	4,400
40 µm tintinnid	800
Dinoflagellates	
Goniaulax catenata	400
Peridinium brevipes	400
Peridinium minusculum	400

Table 56-B

PB 209, 1.5 m depth, 25 ml, 125 X	
Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	40
Peridinium pallidum	40
Flagellates	
Ebria tripartita	180

Table 57-A

PB 210, 0 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros socialis	600
Cylindrotheca closterium	4,200
Nitzschia delicatissima	1,800
Thalassiosira nordenskiöldii	1,800
9 µm	10,800
14 µm, 9 µm spore	2,400
17 µm, 2 µm	1,200
19 µm, 3 µm	600
21 µm, 3 µm	600
27 µm	600
Dinoflagellates	
Dinophysis sp.	600
Goniaulax catenata	600

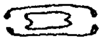
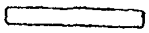
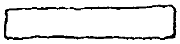
Flagellates	Cells liter^{-1}
Dinobryon balticum	31,800
D. balticum loricae	78,000
Ebria tripartita	2,400
Euglenoid 20 µm	600
Platymonas sp. 6 µm	222,000
3 µm	600
3 µm	3,000
empty	1,800
5 µm	21,000
5 µm	24,000
5 µm	600
9 µm	1,800
9 µm	1,200
9 µm	2,400
Cyanophytes	
Merismopedia sp.	8,400
Unknown	
5 µm	19,200
5 µm spore	2,400
9 µm	7,200
12 µm	600
16 µm spore	1,200
17 µm	600
21 µm ciliate	600
21 µm	2,400
53 µm, 36 µm tintinnid	1,200

Table 57-B

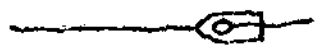
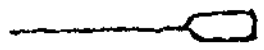
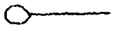
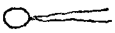
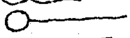
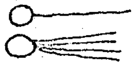
PB 210, 0 m depth, 25 ml, 125 X	
Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	200
Peridinium minusculum	present
Peridinium pallidum	520
Flagellates	
Ebria tripartita	520

Table 58-A

PB 212, 0 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Bacterosira fragilis Gran	400
Chaetoceros compressus	400
Chaetoceros decipiens	3,200
Chaetoceros septentrionalis	1,200
Chaetoceros socialis	2,400
Cylindrotheca closterium	2,800
Nitzschia delicatissima	2,800
5 µm, 7 µm 	800
9 µm 	2,400
12 µm 	400
16 µm, 2 µm 	2,400
27 µm, 7 µm 	400

Dinoflagellates	
Goniaulax catenata	1,200
Peridinium minusculum	800
Peridinium pallidum	400

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	11,600
Dinobryon balticum	7,200
D. balticum loricae	28,800
Ebria tripartita	800
Monosiga marina	400
Platymonas sp. 6 µm 	123,600
3 µm 	800
3 µm 	2,800
empty 	800
3 µm 	3,600
3 µm 	6,000
5 µm 	5,200
7 µm 	4,400
11 µm 	1,200
12 µm 	400

Unknown	
7 µm  spore	4,400
12 µm 	2,000
12 µm 	800

Table 58-B

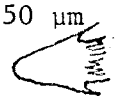
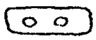
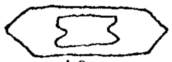
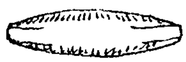
PB 212, 0 m depth, 50 ml, 125 X	
Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	720
Gymnodinium lohmanni	20
Peridinium brevipes	220
Peridinium minusculum	500
Peridinium pallidum	540
Flagellates	
Ebria tripartita	40
Unknown	
50 µm  tintinnid	20

Table 59-A

PB 212, 4 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros compressus	4,000
Chaetoceros decipiens	4,000
Chaetoceros socialis	2,000
Chaetoceros subsecundus	1,200
Cylindrotheca closterium	7,200
Navicula transitans	400
Nitzschia delicatissima	8,000
Thalassiosira nordenskiöldii	2,000
9 µm 	800
10 µm 	400
21 µm, 7 µm 	1,200
36 µm, 5 µm 	400
48 µm, 18 µm 	400

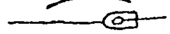
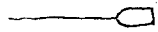
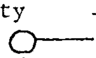
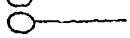
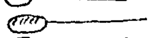
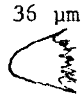
Flagellates	Cells liter^{-1}
Calycomonas vangoorii	16,800
Dinobryon balticum	4,400
D. balticum loricae	96,400
Ebria tripartita	400
Platymonas sp. 6 µm 	62,800
Salpingoeca sp. 3 µm 	400
3 µm 	400
3 µm 	6,800
empty 	2,400
3 µm 	8,400
3 µm 	5,200
3 µm 	3,500
5 µm 	400
6 µm	4,200
7 µm 	7,200
9 µm 	2,000
Unknown	
5 µm 	4,800
7 µm  spore	1,600
36 µm, 44 µm  tintinnid	800

Table 59-B

PB 212, 4 m depth, 50 ml, 125 X

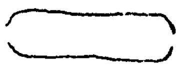
Diatoms	Cells liter^{-1}
Navicula transitans	40
36 µm 	20
Dinoflagellates	
Peridinium brevipes	60
Peridinium minusculum	160
Peridinium pallidum	160
Flagellates	
Ebria tripartita	120

Table 60-A

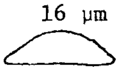
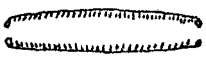
PB 213, 0 m depth, 5 ml, 500 X			
Diatoms	Cells liter^{-1}	Flagellates	Cells liter^{-1}
Chaetoceros atlanticus	400	*Calycomonas vangoorii*	14,000
Chaetoceros compressus	2,000	*Dinobryon balticum*	10,000
Chaetoceros decipiens	5,600	*D. balticum* loricae	57,600
Chaetoceros socialis	5,200	*Platymonas* sp.	59,200
Cylindrotheca closterium	2,000	3 µm	4,800
Nitzschia delicatissima	6,400	empty	2,000
Thalassiosira gravida	800	3 µm	4,000
Thalassiosira nordenskiöldii	800	3 µm	3,600
18 µm		3 µm	5,600
		6 µm	5,600
	1,600	7 µm	4,000
41 µm		7 µm	1,600
		9 µm	800
	800	9 µm	400
		9 µm	1,600
Dinoflagellates			
		Unknown	
Goniaulax catenata	400	9 µm spore	5,600
Peridinium brevipes	400	11 µm ciliate	400
Peridinium minusculum	400	17 µm	800

Table 60-B

PB 213, 0 m depth, 50 ml, 125 X	
Diatoms	Cells liter^{-1}
71 µm 	20
Dinoflagellates	
Dinophysis arctica	20
Goniaulax catenata	340
Peridinium brevipes	100
Peridinium minusculum	400
Peridinium pallidum	360

Table 61-A

PB 213, 8 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros atlanticus	1,200
Chaetoceros compressus	12,800
Chaetoceros decipiens	33,200
Chaetoceros furcellatus spores	32,400
Chaetoceros septentrionalis	5,200
Chaetoceros socialis	1,131,200
Chaetoceros subsecundus	400
Chaetoceros wighami	50,800
Cylindrotheca closterium	14,400
Eucampia zoodiacus	10,400
Fragilariopsis spp.	22,400
Leptocylindrus danicus Cleve	1,600
Navicula debilissima	400
Navicula directa	400
Navicula transitans	1,200
Nitzschia delicatissima	256,600
Nitzschia frigida	400
Nitzschia seriata	4,800
Nitzschiella acicularis	800
Porosira glacialis	2,400
Rhizosolenia hebetata f. *semispina*	400
Thalassiosira gravida	2,400
Thalassiosira nordenskiöldii	40,800
16 µm 	400
21 µm 	400
33 µm 	400
98 µm, 9 µm 	1,600

Dinoflagellates	Cells liter^{-1}
Katodinium sp. 12 µm	400
19 µm 	800
Flagellates	
Diaphanoeca grandis	400
Dinobryon balticum loricae	2,400
Monosiga marina	400
Platymonas sp. 5 µm	3,200
3 µm	800
3 µm	400
5 µm	2,000
5 µm	4,800
7 µm	400
9 µm	400
16 µm	400
Unknown	
12 µm	400
12 µm	1,600
12 µm	10,000
16 µm	400
17 µm	400
36 µm ciliate	800
71 µm ciliate	800

Table 61-B

PB 213, 8 m depth, 50 ml, 312 X

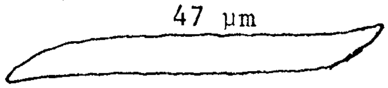
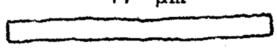
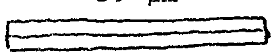
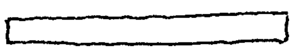
Diatoms	Cells liter^{-1}
Bacterosira fragilis	360
Chaetoceros atlanticus	500
Chaetoceros compressus	9,580
Chaetoceros convolutus	220
Chaetoceros subsecundus	280
Coscinodiscus radiatus	180
Cylindrotheca closterium	6,000
Eucampia zoodiacus	5,840
Fragilariopsis spp.	900
Gyro-Pleurosigma sp.	
47 µm 	20
Leptocylindrus danicus	360
Melosira juergensi	640
Navicula directa	680
Navicula transitans	1,800
Nitzschia frigida	300
Nitzschia seriata	320
Nitzschiella acicularis	960
Porosira glacialis	940
Rhizosolenia hebetata f. *semispina*	200
Thalassiosira gravida	1,760
Thalassiosira nordenskiöldii	24,980
47 µm 	160
59 µm 	6,610
118 µm 	40
Dinoflagellates	
Peridinium brevipes	40
Peridinium minusculum	140
Peridinium pallidum	40

Table 62-A

PB 215, 0 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros compressus	6,400
Chaetoceros decipiens	1,600
Chaetoceros socialis	8,800
Chaetoceros subsecundus	800
Cylindrotheca closterium	800
Nitzschia frigida	400
Rhizosolenia hebetata f. *semispina*	400
Thalassiosira nordenskiöldii	400

Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	400
Peridinium belgicum	400
Peridinium brevipes	800
Peridinium minusculum	800

Unknown	Cells liter^{-1}
1 µm	400
5 µm	2,800
7 µm	1,200
16 µm	800
16 µm	400
9 µm × 21 µm	400

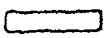
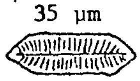
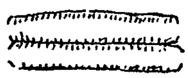
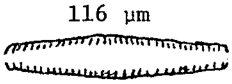
Flagellates	Cells liter^{-1}
Calycomonas vangoorii	6,400
Dinobryon balticum	7,600
D. balticum loricae	97,600
Monosiga marina	1,600
Platymonas sp. 6 µm	21,600
3 µm	800
3 µm	8,400
empty	2,000
3 µm	1,200
3 µm	3,200
3 µm	3,600
5 µm	400
5 µm	7,200
5 µm	400
7 µm	8,400
7 µm	2,400
9 µm	800
9 µm	400

Table 62-B

PB 215, 0 m depth, 50 ml, 125 X	
Diatoms	Cells liter^{-1}
Gyrosigma faciola (Ehrenberg) Cleve	20
Dinoflagellates	
Goniaulax catenata	540
Peridinium brevipes	180
Peridinium minusuclum	360
Peridinium pallidum	200
17 µm 	present

Table 63-A

PB 215, 8 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros atlanticus	1,200
Chaetoceros compressus	21.200
Chaetoceros decipiens	2,000
Chaetoceros furcellatus spores	20,000
Chaetoceros septentrionalis	1,200
Chaetoceros socialis	1,048,800
Chaetoceros wighami	54,000
Chaetoceros sp.	10,000
Cylindrotheca closterium	15,200
Eucampia zoodiacus	20,000
Fragilariopsis spp.	1,200
Navicula transitans	1,200
Nitzschia delicatissima	317,600
Nitzschia frigida	800
Nitzschiella acicularis	400
Porosira glacialis	2,400
Rhizosolenia hebetata f. *semispina*	1,200
Thalassiosira gravida	3,600
Thalassiosira nordenskiöldii	31,600
12 µm, 2 µm 	800
18 µm  spores	13,200
35 µm 	400
44 µm 	800
116 µm 	400

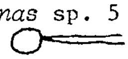
Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	400
Peridinium minusculum	400
Flagellates	
Monosiga marina	400
Platymonas sp. 5 µm 	400
12 µm 	2,000
Unknown	
5 µm  spore	6,800
9 µm 	800

Table 63-B

PB 215, 8 m depth, 25 ml, 125 X

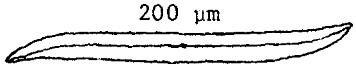
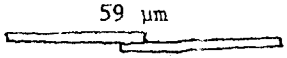
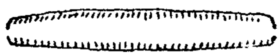
Diatoms	Cells liter^{-1}	Dinoflagellates	Cells liter^{-1}
Chaetoceros atlanticus	680	*Gymnodinium lohmanni*	160
Coscinodiscus radiatus	40	*Peridinium minusculum*	40
Cylindrotheca closterium	6,280	*Peridinium pallidum*	120
Eucampia zoodiacus	4,640		
Gyro-Pleurosigma sp.			
200 µm 	80		
Melosira juergensi	240		
Navicula directa	440		
Navicula transitans	1,800		
Nitzschia frigida	720		
Nitzschiella acicularis	1,000		
Porosira glacialis	840		
Thalassiosira gravida	1,240		
Thalassiosira nordenskiöldii	18,760		
27 µm 	40		
59 µm 	400		
107-157 µm 	320		
200 µm 	40		

Table 64-A

PB 216, 0 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros compressus	8,800
Chaetoceros decipiens	8,000
Chaetoceros septentrionalis	3,200
Chaetoceros socialis	42,000
Chaetoceros wighami	4,000
Cylindrotheca closterium	14,800
Eucampia zoodiacus	400
Thalassiosira gravida	800
Thalassiosira nordenskiöldii	3,600
9 µm	4,000
14 µm	1,600
16 µm	400
7 µm × 18 µm	400
18 µm	400
3 µm × 23 µm	1,600
7 µm × 25 µm	400
31 µm	400
45 µm	400
5 µm × 45 µm	400

Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	400
Gymnodinium lohmanni	400
Peridinium minusculum	2,400
Peridinium pallidum	800
Peridinium trochoideum	400
Flagellates	
Calycomonas vangoorii	13,600
Dinobryon balticum	8,000
D. balticum loricae	32,400
Monosiga marina	400
Platymonas spp. 6 µm	146,800
9 µm	400
Salpingoeca sp. 6 µm	800
3 µm	400
3 µm	2,800
2 µm	1,600
3 µm	19,200
3 µm	28,400
5 µm	400
5 µm	1,200
7 µm	2,000
7 µm	2,000
7 µm	9,600
9 µm	400
12 µm	3,600
12 µm	800
13 µm	400
14 µm	2,000
18 µm	1,200
Unknown	
3 µm	800
7 µm spore	6,400
23 µm spore	400
27 µm	400
32 µm	800
89 µm ciliate	400

Table 64-B

PB 216,	0 m depth,	50 ml,	125 X

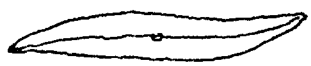
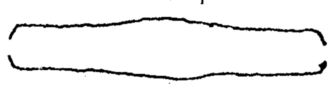
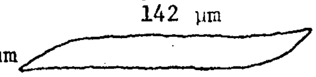
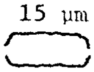
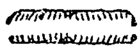
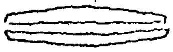
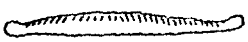
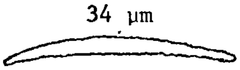
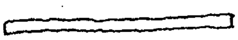
Diatoms	Cells liter^{-1}
Gyro-Pleurosigma sp.	
156 μm	
	40
Navicula transitans	20
45 μm	
	20
Dinoflagellates	
Peridinium brevipes	80
Peridinium minusuclum	280
Peridinium pallidum	180
Peridinium trochoideum	present
Flagellates	
Ebria tripartita	140

Table 65-A

PB 216, 5 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros compressus	4,400
Chaetoceros decipiens	2,800
Chaetoceros septentrionalis	2,800
Chaetoceros socialis	26,800
Cylindrotheca closterium	10,800
Eucampia zoodiacus	400
Gyro-Pleurosigma sp.	
142 µm, 9 µm 	400
Nitzschia delicatissima	8,000
Pinnularia sp.	
34 µm 	400
Thalassiosira nordenskiöldii	2,000
15 µm 	800
21 µm 	1,200
23 µm 	400
27 µm 	400
30 µm 	400
34 µm 	400
77 µm, 3 µm 	400

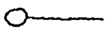
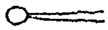
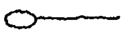
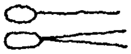
Flagellates	Cells liter^{-1}
Calycomonas vangoorii	3,200
Dinobryon balticum	2,800
D. balticum loricae	29,600
Ebria tripartita	1,200
Monosiga marina	400
Platymonas sp. 6 µm	159,200
3 µm 	800
3 µm 	2,800
3 µm 	4,800
3 µm 	11,600
5 µm 	2,400
7 µm 	400
14 µm 	3,600
Unknown	
5 µm 	800
7 µm  spore	4,400
9 µm 	1,200
9 µm spore	10,000
16 µm 	400
17 µm 	400
Dinoflagellates	
Peridinium pallidum	400
22 µm 	1,400

Table 65-B

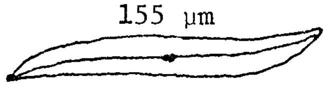
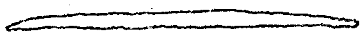
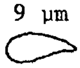
PB 216, 5 m depth, 50 ml, 125 X	
Diatoms	**Cells liter^{-1}**
Gyro-Pleurosigma sp.	
155 µm 	20
Navicula transitans	20
136 µm 	40
Dinoflagellates	
Goniaulax catenata	20
Peridinium brevipes	80
Peridinium minusculum	260
Peridinium pallidum	300
Peridinium trochoideum	present
Flagellates	
Ebria tripartita	120

Table 66-A

PB 217, 0 m depth, ·5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros compressus	1,200
Chaetoceros socialis	2,000
Cylindrotheca closterium	4,400
Nitzschia delicatissima	1,200
Thalassiosira nordenskiöldii	2,000
5 µm  spore	400
9 µm 	4,800
Dinoflagellates	
Goniaulax catenata	800
Peridinium belgicum	400
Peridinium brevipes	800
Peridinium minusculum	400
Peridinium pallidum	800

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	3,600
Dinobryon balticum	2,400
D. balticum loricae	43,600
Ebria tripartita	400
Platymonas sp. 5 µm	140,400
3 µm	4,800
empty	1,600
3 µm	1,200
5 µm	4,000
5 µm	7,200
5 µm	12,800
7 µm	2,400
10 µm	800
Unknown	
5 µm	400
5 µm spore	1,600
5 µm	5,600
7 µm spore	1,600
9 µm	5,200
9 µm spore	2,800
18 µm	400
23 µm	800
27 µm	2,400

Table 66-B

PB 217, 0 m depth, 50 ml, 125 X

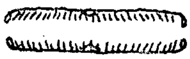
Diatoms	Cells liter^{-1}
43 µm 12 µm 	20
Dinoflagellates	
Goniaulax catenata	260
Peridinium brevipes	20
Peridinium minusculum	100
Peridinium pallidum	500

Table 67-A

PB 217, 5 m depth, 5 ml, 500 X

Diatoms	Cells $liter^{-1}$
Bacterosira fragilis	800
Chaetoceros compressus	7,200
Chaetoceros septentrionalis	1,200
Chaetoceros socialis	65,600
Chaetoceros wighami	800
Chaetoceros sp. 21 µm, 11 µm	2,000
Cylindrotheca closterium	18,000
Eucampia zoodiacus	1,600
Nitzschia delicatissima	114,400
Nitzschia sp. 55 µm, 5 µm	400
Thalassiosira gravida	1,200
Thalassiosira nordenskioldii	6,000
9 µm	2,400
12 µm, 3 µm	400
16 µm spore	6,400
21 µm, 5 µm	400
30 µm, 2 µm	400
30 µm, 2 µm	800
45 µm, 12 µm	800
102 µm, 3 µm	400

Flagellates	Cells $liter^{-1}$
Dinobryon balticum	1,200
D. balticum loricae	38,000
Ebria tripartita	800
Euglenoid 27 µm	400
Platymonas sp. 5 µm	15,600
3 µm	1,200
3 µm	400
empty	400
5 µm	1,600
5 µm	2,000
12 µm	800
Unknown	
5 µm	1,600
9 µm spore	800
9 µm spore	11,200
9 µm	6,400
23 µm	400

Table 67-B

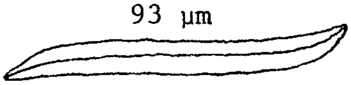
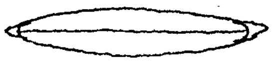
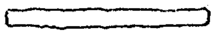
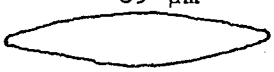
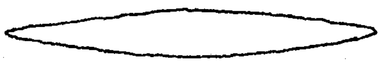
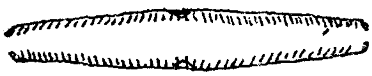
PB 217, 5 m depth, 50 ml, 125 X		
	Diatoms	Cells liter^{-1}
Gyro-Pleurosigma sp.		
	93 µm 	20
Pinnularia sp.		
	57 µm 	20
9 µm	57 µm 	60
4 µm	71 µm 	80
10 µm	89 µm 	20
9 µm	146 µm 	20
12 µm	213 µm 	20
	Dinoflagellates	
Peridinium pallidum		40
	Flagellates	
Ebria tripartita		200
	Unknown	
40 µm		20

Table 68-A

PB 218, 0 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros compressus	400
Cylindrotheca closterium	6,000
Nitzschia delicatissima	2,700
Thalassiosira nordenskiöldii	1,200
7 µm	2,800
12 µm, 4 µm	400
16 µm spore	3,600
20 µm, 2 µm	400
28 µm, 2 µm	400
32 µm, 2 µm	800
84 µm, 4 µm	400

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	2,000
Dinobryon balticum	2,000
D. balticum loricae	94,800
Ebria tripartita	1,200
Euglenoid 25 µm	800
Platymonas 5 µm	104,800
3 µm	5,600
empty	2,800
5 µm	5,600
5 µm	4,400
5 µm	1,600
9 µm	800
9 µm	400
9 µm	400

Unknown	Cells liter^{-1}
5 µm	8,400
9 µm	3,200
9 µm spore	1,600
10 µm	400
45 µm tintinnid	800
72 µm	400

Table 68-B

PB 218, 0 m depth, 50 ml, 125 X

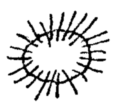
	Diatoms	Cells liter^{-1}
Navicula directa		20
	Dinoflagellates	
Goniaulax catenata		40
Peridinium pallidum		280
	Flagellates	
Ebria tripartita		80
	Unknown	
35 μm 		20

Table 69-A

PB 219, 0 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros compressus	400
Chaetoceros septentrionalis	800
Chaetoceros socialis	3,200
Cylindrotheca closterium	6,000
Cylindrotheca sp.	
93 µm	
3 µm	400
Nitzschia delicatissima	6,400
Thalassiosira nordenskioldii	1,600
7 µm	400
10 µm	
6 µm spore	1,200
21 µm	
2 µm	400
30 30 µm	
5 µm	1,200
32 µm	
2 µm	800
35 µm	
7 µm	400

Dinoflagellates	
Goniaulax catenata	400
Peridinium minusculum	800
Peridinium pallidum	400

Flagellates	Cells liter^{-1}
Calycomonas vangoorii	1,600
Dinobryon balticum	4,800
D. balticum loricae	33,600
Ebria tripartita	400
Platymonas sp. 5 µm	174,000
3 µm empty	2,400
3 µm	2,400
4 µm	3,200
5 µm	1,600
5 µm	2,400
9 µm	400
12 µm	400

Unknown	
5 µm spore	400
7 µm spore	3,600
9 µm spore	8,400
9 µm	3,600
17 µm	2,400
35 µm	2,000
71 µm	400
75 µm tintinnid	2,800

Table 69-B

PB 219,	0 m depth,	50 ml,	125 X

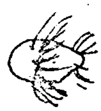
Dinoflagellates	Cells liter^{-1}
Peridinium belgicum	present
Peridinium minusculum	20
Peridinium pallidum	620
Flagellates	
Ebria tripartita	40
Unknown	
38 μm 	20

Table 70-A

PB 219, 5 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Chaetoceros compressus	800
Chaetoceros septentrionalis	1,200
Chaetoceros socialis	6,800
Cylindrotheca closterium	11,600
Nitzschia delicatissima	10,400
Thalassiosira gravida	400
Thalassiosira nordenskioldii	2,400
18 µm	400
20 µm	400
25 µm	400
57 µm, 26 µm	400

Dinoflagellates	Cells liter^{-1}
Goniaulax catenata	400
Peridinium minusculum	400
Peridinium pallidum	800

Flagellates	Cells liter^{-1}
Dinobryon balticum	10,400
D. balticum loricae	56,800
Ebria tripartita	400
Monosiga marina	400
Platymonas sp. 6 µm	66,400
3 µm	800
3 µm	6,800
empty	800
3 µm	3,600
3 µm	6,800
5 µm	5,200
9 µm	1,200
9 µm	1,600
10 µm	800

Unknown	Cells liter^{-1}
7 µm spore	4,800
7 µm spore	800
10 µm	2,000
12 µm	800
46 µm	400

Table 70-B

PB 219, 5 m depth, 50 ml, 125 X

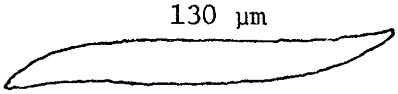
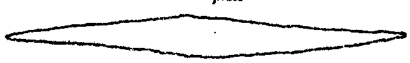
Diatoms	Cells liter^{-1}
Gyro-Pleurosigma sp.	
130 µm 9 µm 	20
Navicula directa	40
151 µm 7 µm 	20
Dinoflagellates	
Dinophysis arctica	20
Goniaulax catenata	20
Peridinium minusuclum	120
Peridinium pallidum	160
Flagellates	
Ebria tripartita	40

Table 71-A

PB 223, 0 m depth, 5 ml, 500 X

Diatoms	Cells liter^{-1}
Achnanthes sp.	
27 µm	
7 µm	
27 µm	1,800
10 µm	
Cylindrotheca closterium	1,200
9 µm	
2 µm	1,200
9 µm	
	3,600
16 µm	
3 µm	600
18 µm	
7 µm spore	600
25 µm	
12 µm	600
25 µm	
3 µm	1,200
27 µm	
2 µm	600
36 µm	
2 µm	600
70 µm	
2 µm	600

Flagellates	Cells liter^{-1}
Dinobryon balticum	2,400
D. balticum loricae	15,000
Dinobryon sociale Ehrenberg	600
Ebria tripartita	3,600
Platymonas sp. 6µm	49,800
Rhodomonas minuta Skuja	600
3 µm	4,200
empty	600
5 µm	18,600
5 µm	19,800
5 µm	600
5 µm, 7 µm	600
9 µm	600
9 µm	4,200

Cyanophytes

Oscillatoria sp.	10,800

Unknown

5 µm	45,600
5 µm	2,400
9 µm	2,400
21 µm	1,200

Table 71-B

PB 223,	0 m depth,	25 ml,	125 X

Dinoflagellates	Cells $liter^{-1}$
Dinophysis arctica	40
Peridinium pallidum	40
Flagellates	
Ebria tripartita	120

APPENDIX III

Statistical Analysis of the Results

1) One way analysis of variance of the primary productivity results. All data are converted to logarithms.

A) Comparison of the data from inside Prudhoe Bay and the deep layer, taken during Cruise I.

	Sums of Squares	d.f.	Mean Square	F calc.	F(P=0.05)
Between areas	0.0730	1	0.0730	0.35	5.59
Within areas	1.4452	7	0.2064		
TOTAL	1.5182				

B) Comparison of the data from inside Prudhoe Bay and the deep layer, taken during Cruise III.

	Sums of Squares	d.f.	Mean Square	F calc.	F(P=0.05)
Between areas	0.4002	1	0.4002	12.93	7.71
Within areas	0.1238	4	0.0309		
TOTAL	0.5240				

C) Comparison of the data from the shallow brackish layer and the deep layer, taken during Cruise III.

	Sums of Squares	d.f.	Mean Square	F calc.	F(P=0.05)
Between areas	0.2617	1	0.2617	3.94	4.75
Within areas	0.7978	12	0.0665		
TOTAL	1.0595				

2) One way analysis of variance of the chlorophyll results. All data are converted to logarithms.

A) Comparison of the Cruise III replicate samples, analyzed by the UNESCO technique, and caluclation of 95% confidence limits.

	Sums of Squares	d.f.	Mean Square	F calc.	F(P=0.05)
Between stat.	1.1026	13	0.0848	13.26	2.49
Within stat.	0.0896	14	0.0064		
TOTAL	1.1922				

t(P=0.025) = 2.145 95% confidence interval = $\overset{\times}{\div}$1.32.

B) Comparison of the Cruise III replicate samples, analyzed by the technique of Lorenzen, and calculation of 95% confidence limits.

	Sums of Squares	d.f.	Mean Square	F calc.	F(P=0.05)
Between stat.	0.4964	13	0.0382	0.99	2.49
Within stat.	0.5376	14	0.0384		
TOTAL	1.0341				

t(P=0.025) = 2.145 95% confidence interval = $\overset{\times}{\div}$1.98.

C) Comparison of the data from inside Prudhoe Bay and the deep layer, taken during Cruise I.

	Sums of Squares	d.f.	Mean Square	F calc.	F(P=0.05)
Between areas	0.1538	1	0.1538	1.89	4.45
Within areas	1.3036	17	0.0815		
TOTAL	1.4574				

D) Comparison of the data from inside Prudhoe Bay and the deep layer, taken during Cruise III.

	Sums of Squares	d.f.	Mean Square	F calc.	F(P=0.05)
Between areas	0.4275	1	0.4275	8.50	4.32
Within areas	1.0559	21	0.0503		
TOTAL	1.4834				

E) Comparison of the data from the shallow brackish layer and the deep layer, taken during Cruise III.

	Sums of Squares	d.f.	Mean Square	F calc.	F(P=0.05)
Between areas	0.3559	1	0.3559	10.03	4.30
Within areas	0.7809	22	0.0355		
TOTAL	1.1368				

F) Comparison of the Cruise I, II, and III data, taken inside Prudhoe Bay.

	Sums of Squares	d.f.	Mean Square	F calc.	F(P=0.05)
Between areas	0.2568	2	0.1284	3.04	3.28
Within areas	1.4359	34	0.0422		
TOTAL	1.6928				

3) Calculation of the 95% confidence interval on the replicate chlorophyll data from Cruise III. Data not in logarithms.

A) Data analyzed by the UNESCO technique.

	Sums of Squares	d.f.	Mean Square	F calc.	F(P=0.05)
Between stat.	6.572	13	0.505	7.43	2.49
Within stat.	0.955	14	0.068		
TOTAL	7.527				

t(P=0.025) = 2.145 95% confidence interval = ±0.4 mg m^{-3}

B) Data analyzed by the Lorenzen technique.

	Sums of Squares	d.f.	Mean Square	F calc.	F(P=0.05)
Between stat.	1.797	13	0.138	1.08	2.49
Within stat.	1.805	14	0.128		
TOTAL	3.602				

t(P=0.025) = 2.145 95% confidence interval = ±0.5 mg m^{-3}

4) Difference in the results obtained by the Lorenzen and UNESCO techniques. The Lorenzen results were subtracted from the corresponding UNESCO results at each station and a mean was calculated.

$n = 44$

$\overline{X} = 0.053$

$S^2 = 0.145$

$S = 0.381$

$Z = 0.96$ (P=0.66)

5) Effect of preserving the alkalinity samples with $HgCl_2$.

Data

Preserved	Control
2.11	2.18
2.11	2.10
2.11	2.10
2.10	2.10
2.09	2.15
2.01	2.10

	Sums of Squares	d.f.	Mean Square	F calc.	F(P=0.05)
Between cells	0.003	1	0.003	2.54	5.14
Within cells	0.014	10	0.001		
TOTAL	0.017				

F(P=0.20) = 2.13